CHARACTERISTICS OF SOILS ASSOCIATED WITH GLACIAL TILLS IN NORTHEASTERN ILLINOIS

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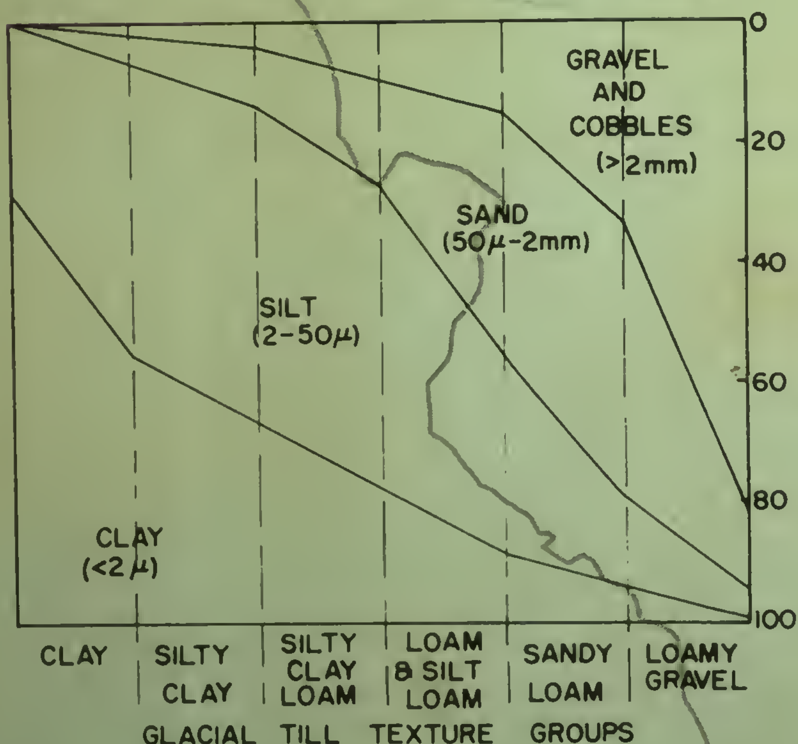

DIFFERENCES IN TILL TEXTURE ARE AMONG THE MOST IMPORTANT PROPERTIES THAT CHARACTERIZE THE SOILS OF NORTHEASTERN ILLINOIS

Characteristics of Soils Associated With Glacial Tills in Northeastern Illinois

By Herman L. Wascher, John D. Alexander,
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CONTENTS

In this bulletin data from physical, chemical, and mineralogical analyses and field studies are used to characterize 33 representative soil profiles of 17 different soil series from three Great Soil Groups — Gray-Brown Podzolic, Brunizem (Prairie), and Humic-Gley.

Because of the important role glacial till plays in the identification and classification of the soils, considerable information is presented characterizing the kinds of glacial till in northeastern Illinois. Different kinds of till result in differences in the morphology of the soil profiles — the key to proper soil classification in this area.

Included in the illustrations are two color plates showing differences in till textures and in soil profiles. A table of correlated soil series is given in the pocket inside the back cover. Also in the pocket is a colored map showing location and extent of areas of soils associated with loamy gravel, sandy loam, loam and silt loam, silty clay loam, silty clay, and clay textures of till. This map also shows areas of soils developed from medium- and fine-textured water-deposited sediments as well as wind- and water-deposited sandy materials.

Detailed field descriptions and laboratory data are given in the appendixes. A list of references to related studies is included.

Characteristics of Soils Associated With Glacial Tills in Northeastern Illinois

The soils of northeastern Illinois developed primarily in glacial till and outwash of different textures and in loess of various thicknesses on the till and outwash. These soils vary widely in their properties, and in order to use and manage them most efficiently it is necessary to characterize them and understand their genesis. Toward this end, field and laboratory studies were made of the tills of various textures in northeastern Illinois and the soils associated with them. The results of these studies are reported in this publication.

PURPOSE AND METHOD OF STUDY

The four major objectives of this study were as follows:

1. Determine through field studies and laboratory analyses the properties and distribution of Wisconsin-age tills of various textures in northeastern Illinois and the thickness of the loess cover over the glacial tills.

2. Obtain chemical, physical, and mineralogical data to characterize selected Gray-Brown Podzolic, Brunizem, and Humic-Gley soils associated with these glacial tills of different textures.

3. Trace the genesis or development of the soils from their mineral constituents by studying changes due to weathering and resynthesis of minerals.

4. Provide through laboratory and field studies a basis for the proper classification of these soils in northeastern Illinois and their correlation with similar soils in northern Indiana, southern Michigan, and southeastern Wisconsin.

The field studies covered most of the area of Wisconsin glaciation in Illinois, except for limited portions in the east-central and northwestern parts of the state (Figs. 1 and 3). Laboratory determinations were made on samples of important soils developed in glacial tills of different textures selected from areas in which the silty loess cover

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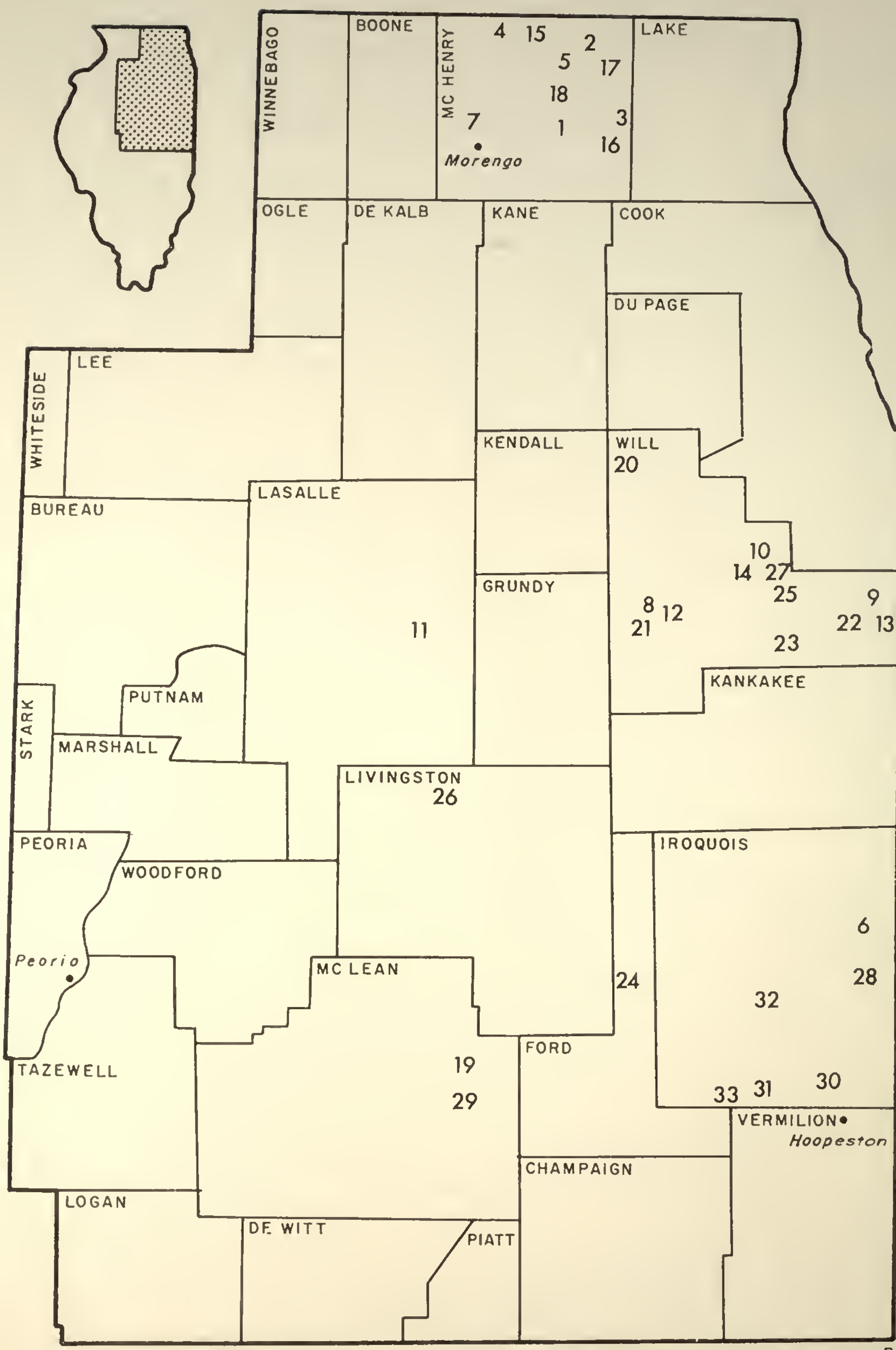


Northeastern Illinois counties or portions of counties included in the field investigations for this study. The numbers 1 through 33 locate the sites at which detailed soil profile descriptions were written and samples were collected. The towns of Marengo, Hoopeston, and Peoria, where weather data were taken, are also shown. (Fig. 1)

is thin or absent. These soils are representative of till-derived soils in Illinois, which occupy approximately 13 percent of the area in the state.

Six textural groups of Wisconsin-age glacial till[1] in Illinois have been recognized, ranging from clay to loamy gravel. For each of these six textural groups of parent material, representative light-colored Gray-Brown Podzolic soils, developed under forest vegetation, dark-colored Brunizem soils, developed under prairie vegetation, and very dark-colored Humic-Gley soils, developed under swampy prairie vegetation, were studied (Table 1). Beecher and Frankfort, two Gray-Brown Podzolic intergrade to Brunizem soils, were also studied. For twelve of the soil series studied, two profiles of each were analyzed.

Table 1. — Soil Series and Profiles Studied in Northeastern Illinois[a]

Texture of underlying glacial till	Gray-Brown Podzolic soils	Gray-Brown Podzolic intergrade to Brunizem soils	Brunizem soils	Humic-Gley soils
Loamy gravel	Fox (1, 2, 3)	....	Warsaw (15, 16)	....
Sandy loam	McHenry (4, 5)	....	Ringwood (17, 18)	....
Loam and silt loam	Miami (6, 7)	....	Saybrook (19, 20)	Drummer (28, 29)[b]
Silty clay loam	Blount (8, 9)	Beecher (12, 13)	Elliott (21, 22, 23)	Ashkum (30)
Silty clay	Eylar (10)	Frankfort (14)	Swygert (24, 25)	Bryce (31, 32)
Clay	Eylar (11)	....	Clarence (26, 27)	Rowe (33)

[a] Each profile studied is identified by a number in parentheses.
[b] The Drummer profiles were developed primarily in water-sorted sediments.

Three profiles each of the Fox and Elliott series and one profile each of the Frankfort, Ashkum, and Rowe series were analyzed. Each of the thirty-three soil profiles studied is identified by a number. Profile descriptions, together with the location of all sampling sites, are given in Appendix A. Their general location is indicated in Fig. 1.

[1] Material of loamy gravel texture, such as underlies Fox and Warsaw soils, seems to be water-sorted even though most sampling sites were in morainic areas. However, the term *till* is used in the text of this bulletin to denote the underlying materials of all soils sampled, rather than the broader term *drift*.

REVIEW OF LITERATURE

Postglacial climate

The type of climate that has prevailed throughout post-Wisconsin glacial time and the length of this period are responsible for certain profile characteristics that distinguish the soils of northeastern Illinois from those of other regions.

Geological evidence. A review of literature by Flint (1947) indicates that temperatures at the maximum of the Wisconsin glaciation were about 9° F. (5° C.) lower than at present and Flint concludes, "it is probable that during the glacial ages the amount of moisture available for precipitation both along the borders of the former ice sheets and in the nonglaciated regions was considerably greater than it is in the same regions today." To him the evidence seems to indicate "climatic fluctuations of considerable amplitude."

From the Scandinavian literature Flint found that postglacial climate in northern Europe reached a maximum of warmth and dryness between 6,000 and 4,000 years ago (approximately 4050 – 2050 B.C.) and has since become more cool and moist. Presumably a *Climatic Optimum,* a term devised by Scandinavians, lasting 2,000 years existed during that time. Flint states that "it (a warm, dry period) is the outstanding fact of so-called postglacial history." As evidence of a corresponding warm, dry period in North America he cites data from pollen analyses of peat bogs, invertebrate marine fossils, saline lakes, and other features.

Russell (1941), in an attempt to reconstruct the climates of the past, reviewed the literature and decided that the weight of evidence suggests that man is now living in an interglacial period and that the climate of this period has been extremely variable and complex. He was uncertain whether this variability could be the result of long-time trends combined with short-time fluctuations or simply unexplainable random fluctuations. He found the evidence of climatic variations more complete for central and western Europe than for North America but felt that "certain sympathetic swings seem to be related even though appearing in observations as widely spaced as different continents or hemispheres."

Combining the results of studies of varves, tree rings, plant succession in peat bogs, and other types of geochronological evidence, Russell concluded that the Arctic climate of the last glacial maximum "gradually passed into the Subarctic period in about 12,000 B.C.," that "accelerated melting occurred in about 8000 B.C.," and that "in about

the year 5000 B.C. the Baltic became warm enough to support types of life that demand temperatures warmer than those of today." He concluded that these "warm and moist conditions lasted from about 5000 B.C. to 3000 B.C." with temperatures high enough that "all small mountain glaciers of the Alps and in the present United States disappeared completely." This period roughly coincides with the warm and dry Climatic Optimum of the Scandinavians.

Ruhe *et al.* (1957) collected peat material from a central Iowa bog that had been divided into layers or zones on the basis of pollen analysis. The uppermost or most recent layer, having a predominance of grass pollen, was denoted as a grassland vegetation zone, and interpreted as resulting from a hotter and drier climate than had existed previously when spruce, fir, birch, and oak forests had presumably covered the landscape. Peat material from the lower part of this "grassland" zone was found to have a radiocarbon date of 6,575 ± 200 years B.P. (before the present) or 4,600 years B.C. This corresponds to the earliest part of the Scandinavian Climatic Optimum and indicates a similarity in climate between the two regions.

Historical evidence prior to the 1850's. From documentary evidence Russell (1941) further found that numerous climatic changes have occurred within historical times or since about 2000 B.C. Evidence of recent glacial activity is part of this climatic record.

During the early 1600's A.D., Alpine glaciers extended far down the valleys. Between 1640 and 1770 A.D. the glaciers retreated but again advanced until about the middle 1800's when they again retreated to positions occupied prior to 1600 A.D. Russell concludes that this last glacial recession "appears to be a worldwide condition," suggesting that the last century (approximately 1840-1940) has had higher average temperatures than the century just preceding.

Recorded data (1856 through 1956). A continental type of climate has prevailed over northeastern Illinois within the memory of man. It is characterized by a wide range in temperature between the extremes of winter and summer and by an irregularly distributed but relatively abundant rainfall. This variety of climate is due to the interchange of cyclonic and anticyclonic air masses passing over the region.

Climatological data from Marengo, Peoria, and Hoopeston weather stations are discussed below.[1] Marengo and Hoopeston stations repre-

[1] Temperature and rainfall data courtesy of Illinois State Water Survey and U.S. Weather Bureau, mostly from J. L. Page (1949).

sent the northern and southern extremes, respectively, of the area from which soil profile samples for this study were collected (see Fig. 1). Data from Peoria are included because they comprise the longest uninterrupted records of any station in this part of the state.

The rainfall records at Marengo cover the 101-year period 1856 through 1956, except for 1917 and 1918. Temperature records cover only the 57-year period 1900 through 1956. All of these records include data collected prior to 1918 at Riley, 3 miles south of Marengo. The records at Hoopeston cover the 54-year period 1903 through 1956, while at Peoria the records for both temperature and rainfall are complete for the 101-year period 1856 through 1956.

The lowest temperature recorded at Marengo was −27° F. (−32.8° C.) in February, 1905, and the highest was 109° F. (42.8° C.) in July, 1936. At Hoopeston the lowest temperature recorded was −25° F. (−31.7° C) in February, 1905, and the highest was 111° F. (43.9° C.) also in July, 1936. Although below-freezing air temperatures may slow many chemical soil-weathering processes and most biological soil activity, higher temperatures up to certain points accelerate both processes. Air temperatures as high as 109° and 111° F. ordinarily do not limit biological activity in soil, particularly if moisture is present.[1]

The average mean monthly temperature at Marengo is near or below freezing (i.e., less than 36° F.) during the five months November through March (Table 2). At Hoopeston the average mean monthly temperature is less than 36° F. only during the three months December, January, and February. Since near- or below-freezing temperatures prevail about 5 months at Marengo and 3 months at Hoopeston, we may assume that the soil surface is at least partially frozen about 4 months each year at Marengo but probably not more than about 2 or 2½ months each year at Hoopeston.

[1] Personal communication from F. J. Stevenson, Associate Professor of Soil Chemistry.

Table 2. — Average Mean Monthly Temperature and Average Monthly Precipitation at Marengo and Hoopeston Weather Stations

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
						Temperature (° F.)							
Marengo...	20.0	22.6	32.9	46.5	57.8	67.7	72.5	70.2	62.6	50.5	35.9	24.3	46.9
Hoopeston.	27.4	29.9	40.0	51.1	61.9	71.4	75.5	73.3	66.5	55.0	41.4	29.9	51.9
						Precipitation (inches)							
Marengo...	1.71	1.63	2.42	2.76	3.55	4.13	3.32	3.42	3.74	2.42	2.06	1.72	32.88
Hoopeston.	2.43	2.06	3.21	3.67	4.06	3.85	3.57	3.27	3.42	2.96	2.61	2.22	37.33

At Marengo the average annual precipitation (rainfall and melted snowfall), 1856 through 1956, was 32.9 inches. This varied from a high of 50.3 inches in 1858 to a low of 19.7 inches in 1901. At Hoopeston the average annual precipitation, 1903 through 1956, was 37.3 inches. It varied from a high of 52.1 inches in 1927 to a low of 27.4 inches in 1914.

Thornthwaite (1948) estimates that the average annual potential water loss through evapotranspiration in this region is 27 inches. This would tend to be slightly lower (approximately 26 inches) at Marengo and slightly higher (approximately 28 inches) at Hoopeston. It would also tend to be slightly higher during warm, dry periods and lower during cool, moist periods. In general the higher amounts of yearly precipitation are adequate to replenish the ground-water supply in addition to providing for all evaporation from the soil and transpiration by plants. Only the lower amounts do not always adequately supply all such needs, and the ground-water table is sometimes lowered to a critical depth for some purposes.

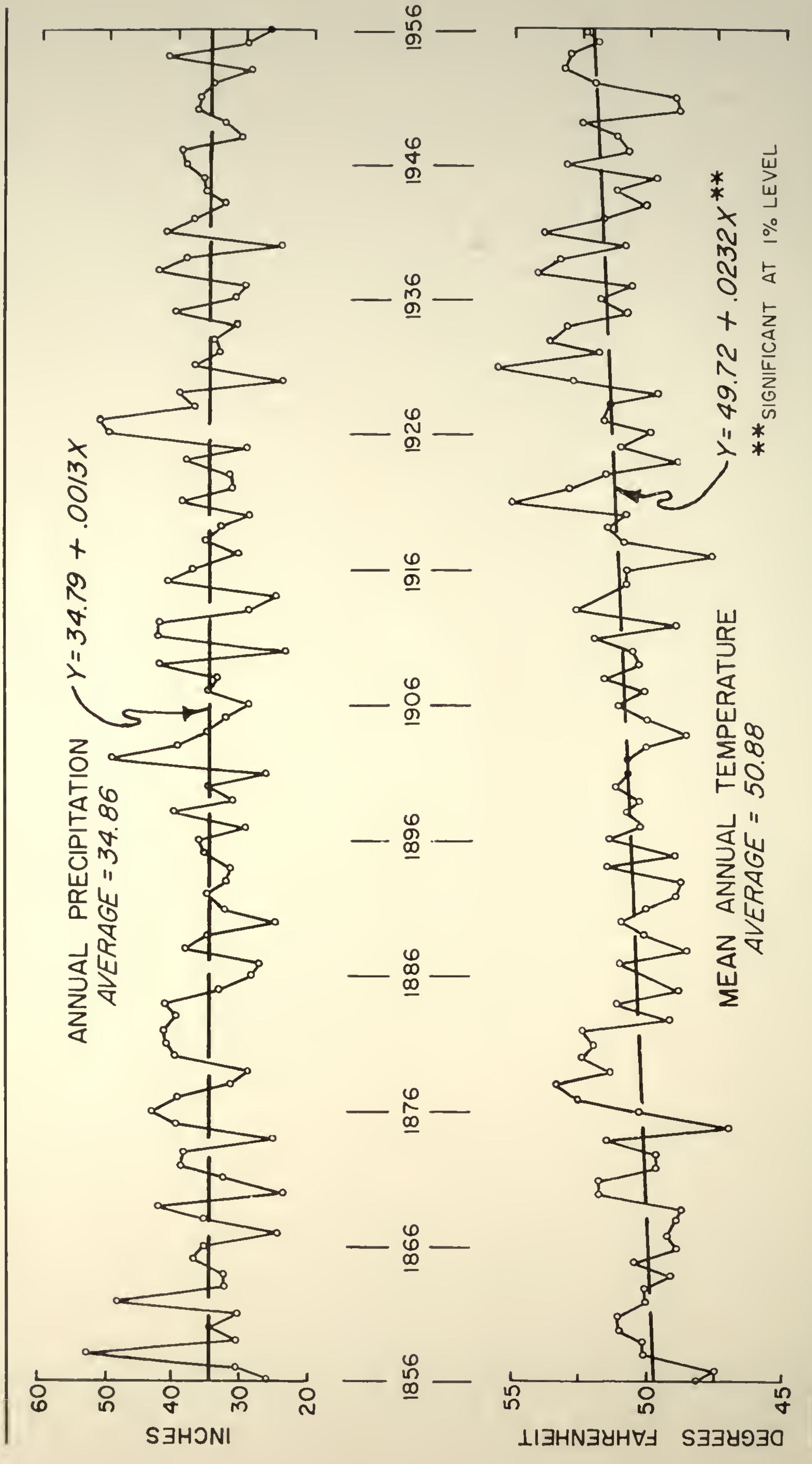
With Hoopeston's higher average mean annual temperature of 5.0° F. (Table 2) and somewhat shorter period of frozen soil surface each year, soil weathering and profile development would be expected to progress faster than at Marengo, but slightly higher evaporation and transpiration rates may offset this tendency toward greater leaching and solution losses from the soil.

Temperature and rainfall data from the Peoria weather station for the 101-year period 1856 through 1956 show the same irregularities as those from Marengo and Hoopeston. Because the data at Peoria are complete for the entire period, trends were calculated from them.

At Peoria the average annual precipitation for the 101 years was 34.9 inches. Although cycles of wetter and dryer periods are indicated and precipitation at times fluctuated more than 20 inches from one year to the next there was no significant trend throughout the 101-year period (Fig. 2). Rainfall data from both Marengo and Hoopeston also indicate no significant increase or decrease.

On the other hand, a highly significant warming trend is indicated by the temperature data from Peoria (Fig. 2). At this station the average mean annual temperature for the 101-year period was 50.9° F. For the first 25-year period it was 50.2° F.; for the second 25 years, 50.2° F.; for the third 25 years, 51.0° F.; and for the last 26 years, 52.0° F.

This warming trend is substantiated not only by the data from Marengo and Hoopeston but also from 15 other weather stations



Yearly fluctuations and longtime trends in rainfall and temperature at Peoria for the 101-year period 1856 through 1956. (Fig. 2)

scattered throughout the area studied that were established prior to 1931. Of these 15 stations, 8 have recorded an average mean annual temperature between 1° and 2° F. higher since 1931 as compared with before 1931. At 6 stations the average mean annual temperature is between 0.5° and 1° F. higher and at one it is less than 0.5° F. higher. No station in northeastern Illinois has recorded a decrease in average mean annual temperature subsequent to 1931 as compared with before 1931.

Landsberg (1958) also reached the conclusion that no significant change in rainfall has occurred but that available data do indicate a rise in temperature of about 2° F. for the last century.

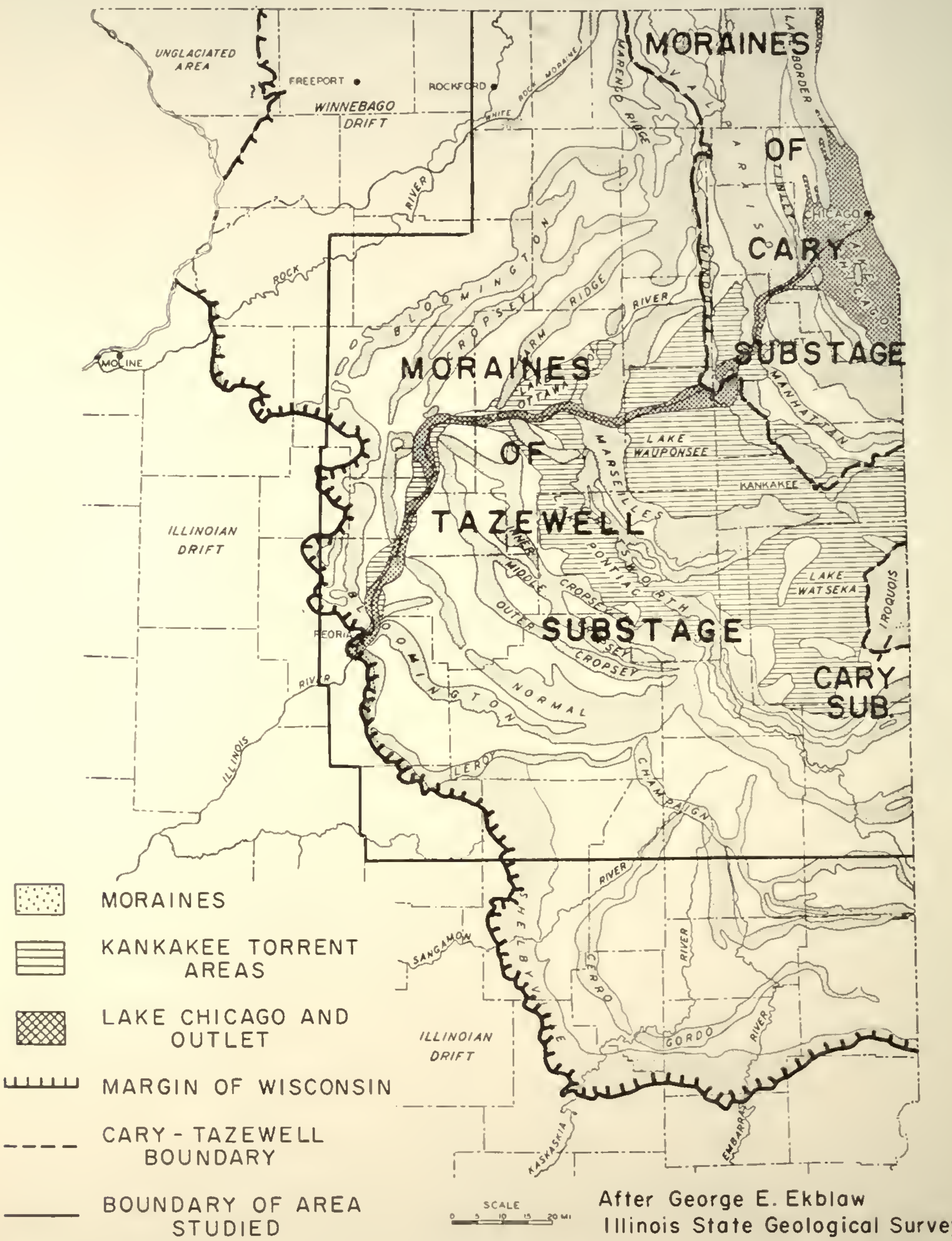
Late Pleistocene history

Extensive investigations of Pleistocene deposits have been made in the United States, Canada, and other parts of the world. Studies of these deposits have been in progress in Illinois and neighboring states for about 80 years.

Classification of materials. Leverett (1899) described numerous stratigraphic sections from well records and personal observations. Many publications of the Illinois State Geological Survey report observations of Pleistocene deposits and interpretations of Pleistocene events in east-central and northern Illinois. Descriptions of some of the most recently observed stratigraphic sections in this part of the state are given by Eveland (1952), Horberg (1953), Leighton and Willman (1953), Horberg and Potter (1955), and Shaffer (1956). These and other publications were consulted in arranging the outline shown in Fig. 4.

Leverett (1899) identified the tills in northeastern Illinois as primarily of Wisconsin glacial age. In the southwestern part of the area studied (Fig. 3), his boundary between Wisconsin and Illinoian tills remains essentially unchanged. However, his outline of the margin of Wisconsin till in the Rock river-Green river basin in the northwestern part of the area studied was subsequently shifted by Leighton (1923) to coincide with the newly discovered White Rock moraine (Fig. 3). Till lying west and north of Leighton's White Rock moraine was suggested by Shaffer (1956) to belong to Farmdale time and was named Farmdale by him. Later Frye and Willman (1960) suggested the name Winnebago for this material and assigned it to the Altonian substage to distinguish time-stratigraphic subdivisions from morphostratigraphic units.

The morainic systems of Wisconsin glacial age in eastern Illinois and western Indiana were divided by Chamberlain (1883) into two substages on the basis of differences of trend and freshness of contour. This division was later extended into northern Illinois by Leverett. The older or Early substage included all of the nearly con-



Moraines, till plains, and major glacial lakes of Wisconsin age in northeastern Illinois. (Fig. 3)

centric moraines from the Shelbyville through the Marseilles (Fig. 3). The younger or Late Wisconsin substage included the combined Minooka-Iroquois and those other moraines in Illinois lying between the Minooka and Lake Michigan. In 1933 Leighton suggested that more distinctive names be applied to the substages of Wisconsin age and, for the two represented in Illinois, proposed *Tazewell* for the Early and *Cary* for the Late (Fig. 3). These names were subsequently applied to till, outwash, and loess deposited during those periods, except that the term *Peorian* was used to designate the multiple loess of middle to late Wisconsin time where the loesses of that period were not separable. Because this loess is generally thought of as a rock-stratigraphic rather than a time-stratigraphic unit, Frye and Willman (1960) dropped the adjectival ending. These authors also preferred to combine Cary and Tazewell into one time-stratigraphic unit and have assigned the name Woodfordian to this unit.

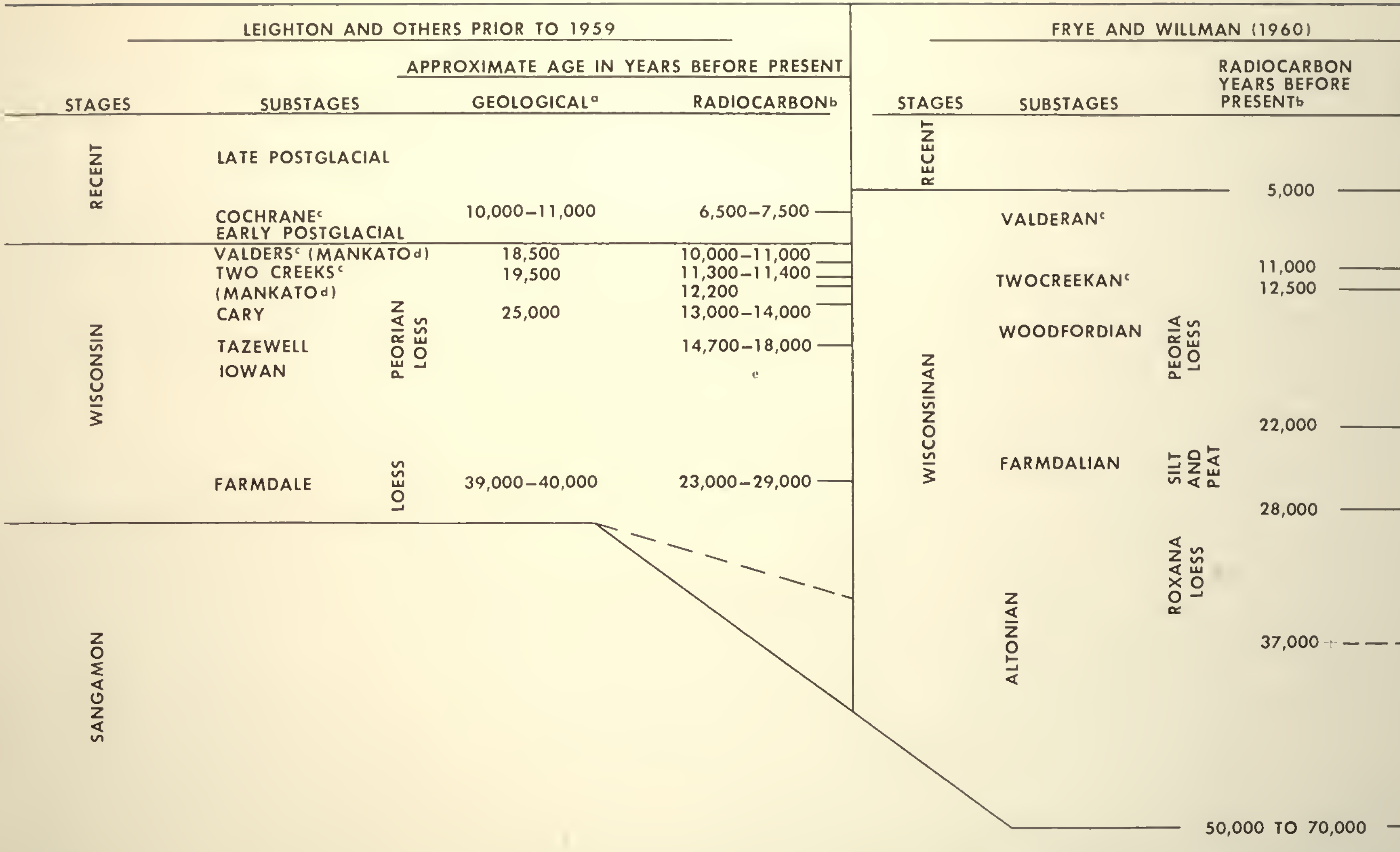
Age of materials. Time relationships among the different Wisconsin glacial substages are shown in Fig. 4. These are estimates based on studies of varves, wave cutting, pollen analyses, depth of leaching, mineralogy, deep-sea sediments, etc., and, more recently radiocarbon (C^{14}) determinations. In general, time estimates based on geological data are nearly twice as long as estimates based upon radiocarbon datings. In making such estimates it is important to use all available sources of information to obtain maximum accuracy.

Early estimates of postglacial time in North America according to Coleman (1929) varied from a maximum of 39,000 years to a minimum of 7,000 years. From his own study of wave cutting in Lake Ontario, Coleman estimated the beginning of Niagara Falls at approximately 25,000 years ago. This presumably occurred near the end of Cary (late Woodfordian) time following the retreat of Cary ice to the north and opening of the St. Lawrence river outlet.

Russell (1941), basing his conclusions on geologic information, suggested that "the last general recession of continental glaciers began about 30,000 to 40,000 years ago" but that the last Arctic period or probable glacial maximum occurred just prior to 12,000 B.C.

A summary of radiocarbon datings by Suess (1956) places the age of Mankato till deposits (Valders by other authorities, see Leighton, 1958) at 10,000 to 11,000 years B.P., Cary at about 13,000 to 14,000 years B.P., and Tazewell at approximately 14,500 to 18,000 years B.P. (Fig. 4).

Ruhe, Rubin, and Scholtes (1957), from radiocarbon datings of



[a] Geological datings are from Coleman (1929), Antevs (1955, 1957), and other sources.
[b] Radiocarbon datings are primarily from Suess (1956), Ruhe *et al.* (1957), Leighton (1958), and Frye and Willman (1960).
[c] Materials belonging to these substages have not been identified in Illinois.
[d] Part of the materials previously identified as Mankato were recorrelated as Valders and part as Cary. Leighton (1958) believes a portion, thought to be between Cary and Two Creeks, should remain separate and be referred to as Mankato.
[e] Radiocarbon datings of materials collected by Ruhe *et al.* (1957) indicate that till of the Iowan substage is older than 34,000 years. This suggests probable pre-Farmdale origin of this till. Farmdale C^{14} dates shown above are of material taken from the loess.

Wisconsin and post-Wisconsin Pleistocene time of the Upper Mississippi Valley. (Fig. 4)

various materials in Iowa, place the age of Cary deposits at 11,600 to 13,300 years B.P., a Tazewell-Cary interstadial at 13,800 to 14,500 years ago, the Tazewell substage at 14,700 to somewhat more than 17,000 years ago, and the Farmdale substage at 24,500 years ago. Pieces of wood from till identified as Iowan age were given C^{14} dates greater than 34,000 years B.P. and from this they concluded that "a possible interpretation of radiocarbon dates from Iowa places the Iowan substage in an older position than the Farmdale."

Agreement between the datings compiled by Suess and those of Ruhe *et al.*, Leighton, and others is close but not exact. Some overlapping exists, particularly in the range given for the Cary substage. This could be due either to an error in correlation of some of the till or possibly to differences in time of deposition of widely separated parts of the till sheet from which data were obtained.

Frye and Willman (1960) presented a revised Wisconsinan time-stratigraphic classification along with results of detailed stratigraphic studies and a few additional radiocarbon datings. They show a radiocarbon dating of snail shells taken from Peoria loess of approximately 17,100 years B.P. and of Shelbyville till of about 19,200 years B.P. The relationship of their classification to that of Leighton *et al.* is shown in Fig. 4.

Antevs (1955, 1957), in appraising radiocarbon datings of late Pleistocene events by pollen analysis and varve counts, suggests that most C^{14} dates are underestimates of actual number of years and unless properly "evaluated in relation to our geological knowledge" should not be taken as the actual age of the material sampled. He believes that "an informed geological estimate is better than a C^{14} date lacking geological support." From a series of varve accumulations Antevs places the Cochrane maximum at 10,000 to 11,000 years B.P., Valders at approximately 18,500 years ago, and the Two Creeks interstadial at about 19,500 years ago. He concluded that the radiocarbon date for the Two Creeks period must be 8,000 or more years too young.

A summary of available information indicates that the soils in northeastern Illinois, particularly those for which detailed descriptions and analytical data are included in this study, were formed from parent materials deposited during late Tazewell or early Cary (middle Woodfordian) time. They have reached their present stage of development in not less than about 13,000 years nor more than about 17,000 years according to radiocarbon datings or in approximately 25,000 to not more than about 40,000 years according to geological evidence.

Soils

Large areas of soils that developed partially or wholly in till of Wisconsin glacial age occur in north-central and northeastern United States and in Canada. The wide variations in these soils are due primarily to differences in parent materials, along with native vegetation and air-and-water relationships. Authors of many soil reports have described the various soil types that have been mapped and have presented other valuable information concerning the geology, climate, and agriculture of individual counties. Certain physical and chemical data for a few soil types and their underlying materials are generally included in each report but no soil has been characterized in detail.

North-central United States. Baldwin, Kellogg, and Thorp (1938) grouped most of the then-recognized till-derived soils of Wisconsin age in north-central United States with the Podzol, Gray-Brown Podzolic, and Prairie (currently called Brunizem) Great Soil Groups. Other less important groups of till-derived soils in this region are Regosol, Planosol, and Humic-Gley.

Podzol soils are found mostly north of the 43rd parallel in Michigan and north of the 45th parallel in Wisconsin and Minnesota. No recognizable areas of Podzol soils occur in Illinois. South of these two parallels the till-derived soils of Wisconsin age are included primarily with Gray-Brown Podzolic and Brunizem groups. Soils of the Regosol, Planosol, and Humic-Gley groups are found more generally with the Gray-Brown Podzolics and Brunizems although in some places small areas also occur with the Podzols.

In the earliest mapping in the north-central states, all soils developed in Wisconsin till were correlated with the Miami series. As soil information increased, other till-derived soil series were recognized and Miami was defined within narrower limits. Because its thick, dark surface differed markedly from the surface layer of associated soils, Miami black clay loam was recorrelated as Clyde silty clay loam. Later Brookston silty clay loam was recognized. In addition to surface-horizon differences, color and texture differences throughout the solum were also given greater recognition. Because some of these solum differences were due to differences in the character of the parent material, Bellefontaine, occurring on coarse-textured till, and St. Clair, occurring on fine-textured till, were eventually established. Thus Miami and its catena associates were finally defined as having developed in calcareous till of medium (loam and silt loam) texture.

Brown and Thorp (1942), reporting on the newer concept of some

soils of the Miami family and Miami catena in Indiana, Ohio, and Michigan, classified the soils of the Miami family with the Gray-Brown Podzolic Great Soil Group. On the basis of similar morphology they decided that these soils (Miami, Wooster, Hillsdale, and Fox) were comparable in development even though the parent material varied in texture and lithology. They found that the B horizons of each of these soils contained more clay than the A or C horizons, that some iron had concentrated in the B, that the aluminum content was noticeably greater in the B than in the A, and that there was some concentration of calcium, phosphorus, and sulfur in the A horizons. This last point they concluded was "doubtless a reflection of the association of these elements with the organic matter."

These authors divided the soils of the Miami catena into four Great Soil Groups on the basis of dissimilar morphology. Miami was placed in the Gray-Brown Podzolic group as indicated above. Crosby and Bethel were classed as Planosols, Brookston as Half-Bog, and Clyde as Wiesenboden. Both Brookston and Clyde are now classified as Humic-Gley. The authors found that the B horizons (H_3 in Brookston and H_2 and H_3 in Clyde) contained the most clay, but that textural differences between A and B horizons were more marked and more abrupt in the Planosols. They further noted that the colloids of the Gray-Brown Podzolic soils averaged slightly lower in silica and higher in iron oxide, aluminum, and combined water than those of either the Planosols or Humic-Gleys.

Mick (1949) described four soil profiles in eastern Michigan and presented data comparing their physical, chemical, and mineralogical properties. The soils were St. Clair, Conover, Nappanee, and Brookston. Mick found that the parent till materials were very similar in appearance, in clay content, and in lithology. He found that St. Clair probably "evolved from a rather uniform parent material" but concluded that Conover, Nappanee, and Brookston "developed in materials showing definite original dissimilarities between surface and subsurface layers." He advanced the hypothesis that the horizon differences of the latter three soils in the area studied were "depositional in nature and that they may have been caused by wave-action which sorted the surface layers as they emerged from the postglacial lakes." He concluded that the characteristics of the B horizons in all four soils were largely inherited from the parent material and that it was "extremely doubtful that the present B horizon is primarily a zone of illuviation, although illuviation has undoubtedly contributed to its characteristics." He further concluded that "horizon comparisons, expressed in terms of

volume rather than weight, indicate that illuviation is probably not so dominant in the formation of the Gray-Brown Podzolic profile as has commonly been supposed."

Illinois. In Illinois the soils developed primarily in till of Wisconsin glacial age are included mostly in the Brunizem, Gray-Brown Podzolic, and Humic-Gley Great Soil Groups. Each group is composed of many series as shown in the key to the soil series (in pocket inside back cover). Some series are correlated across state lines, whereas others are not.

The first recognition in Illinois of the effect of texture of parent till material of Wisconsin age on solum properties was in 1911-1912 during the soil survey of Iroquois county as reported by Mosier *et al.* in 1922. A "brown silt loam on tight clay" was separated from other brown silt loam soils. The tight clay or fine-textured subsoil resulted from parent material of clay to silty clay texture.

In 1929 and 1930 the Soil Survey staff of the Illinois Agricultural Experiment Station, while mapping soils in Ford and Vermilion counties, recognized the importance of texture of till on the soil solum and made additional separations in the brown silt loam soils. The men found that soil series tended to correlate closely with variations in the character of the parent till. They indicated that for soil survey mapping purposes the till in these two counties could be divided into four textural groups. Reporting on this work supplemented by laboratory studies, Winters and Wascher (1935) showed that although the particle-size distribution of calcareous till of Wisconsin age often varied within short distances in the field, the variation was usually gradual and fairly regular when data from a large number of samples were arranged in order of increasing clay content. By relating field studies to laboratory data they established limits of clay content for each of the four recognized till groups as follows:

	<5μ[1] material (percent)	*<2μ material[2] (percent)*	*<1μ material (percent)*
Clarence till	$>62\pm3$	> about 45	$>33\pm2$
Plastic Elliott till (later called Swygert)	62 ± 3 to 52 ± 2	about 45 to 36	33 ± 2 to 27 ± 1
Elliott till	52 ± 2 to 37 ± 1	about 36 to 27	27 ± 1 to 17 ± 1
Saybrook till	$<37\pm1$	< about 27	$<17\pm1$

[1] The symbol μ denotes micron size. One micron is 0.001 millimeter.

[2] The 2μ clay was not determined in the original study. It is estimated by interpolation from the 5μ and 1μ data.

An extension of this work by the same authors (1938) confirmed the results of the previous study; i.e., the calcareous glacial till of Wisconsin age in northeastern Illinois varied gradually and regularly in clay content, and texture groups of this till could be recognized in the field. In addition they found that the average calcium carbonate equivalent in the unleached till varied between groups, being highest in Elliott and lowest in Clarence, although individual samples ranged widely. They further noted that mean depth to carbonates varied with clay content; i.e., leaching had progressed deepest in medium-textured or loam till (Saybrook) and shallowest in fine-textured or clay till (Clarence). Also from this broader study the authors suggested that a fifth till-texture group (Sandy Saybrook) was probably needed.

In the meantime Krumbein (1933) reported mechanical, lithological, and mineralogical data on two suites of calcareous till samples of Wisconsin glacial age. One suite was taken along a north-south traverse near the Illinois-Indiana state line and the other on the Valparaiso moraine from near Joliet, Illinois, around the southern end of Lake Michigan to near Benton Harbor, Michigan. He indicated that certain regional separations based on each type of data probably could be made, but found no close correlation among the three types of data.

Also during this period Stauffer (1935), analyzing complete profiles of three Brunizem soils, found a direct relationship of the clay content of the B horizon to the calcareous parent till in Clarence, Elliott, and Saybrook soils. He found the highest percentage of clay in the B horizon and underlying till in the Clarence soil and the least in Saybrook. However, the difference between the clay content in the B horizon and parent till was least in the Clarence soil and greatest in Saybrook. He also found that carbonates had leached deepest in the Saybrook soil and the least in Clarence. Elliott was between Saybrook and Clarence in all these respects. From this information Stauffer concluded that soil development had progressed farthest in Saybrook, less in Elliott, and least in Clarence.

Pearse (1941) studied six profiles of five Humic-Gley soils from Iroquois county, Illinois. Data from five of these profiles are included in this bulletin. These are profiles numbered 28, 30, 31, 32, and 33.

On the basis of field descriptions Pearse decided that the underlying (parent) materials of Rowe, Bryce, and Ashkum were calcareous till whereas those of Milford and Drummer were outwash. In the three till-derived soils he found that the clay content of the B and C

horizons was highest in Rowe, intermediate in Bryce, and lowest in Ashkum. Volume weight (bulk density) differences were small within comparable horizons of the three soils; swelling, produced by saturation with water, increased the volume about 9 percent. Organic carbon in the A horizon was uniformly high, averaging 3.84 percent. pH values were relatively high. The lowest pH recorded was 5.6 in Rowe at the 18- to 27-inch depth.

Alexander (1951) studied duplicate profiles of three soil series from Will county, Illinois. Samples were collected from a Brunizem (Elliott), a Gray-Brown Podzolic (Blount), and a prairie-forest transition (Beecher) soil from each of two locations. One set of three profiles was obtained from the Valparaiso moraine in east-central Will county and the other about 30 miles west. Data from these soils are included in this bulletin (see profiles numbered 8, 9, 12, 13, 21, and 22).

Maximum clay percentage in all profiles was in the B horizon, but one Beecher (No. 13) had a higher maximum than either its associated Elliott (No. 22) or Blount (No. 9). Exchangeable calcium, magnesium, and sodium were highest in Elliott, intermediate in Beecher, and lowest in Blount in the A horizon but were variable in the B horizon. Exchangeable potassium varied, but considering the whole solum it averaged highest in Elliott and lowest in Blount. Volume weights (bulk densities) were highest in Blount and lowest in Elliott in the upper 10 to 12 inches, but below this depth they were about the same within any one horizon.

Hallbick (1952) compared the morphology and some physical, chemical, and lithological data of one profile each of Miami, McHenry, and Fox soils. He decided that in all three of these soils, which belong in the Gray-Brown Podzolic Great Soil Group, texture of underlying till was useful in distinguishing them. He found that the calcareous till underlying Fox contained 72 percent material of gravel size (>2 mm.), McHenry 36 percent, and Miami 6 percent. Of this coarse material, 75 percent was limestone (including dolomite) in the Fox and McHenry profiles, whereas only about 32 percent was limestone in Miami. Data from these profiles (numbered 1, 4, and 6) are included in this bulletin.

Pederson (1954) studied six profiles of Elliott soil, four from Illinois and two from Wisconsin. Of the Illinois profiles, he selected two from areas of till of the Late Tazewell substage and two from areas of till of the Early Cary substage. The two profiles from Wisconsin were sampled in an area of the Cary substage of Wisconsin glaciation.

Pederson decided that the morphological characteristics of Elliott were within the range of Brunizem (then called Prairie) soils. He calculated in pounds per acre the loss of carbonate minerals by leaching and found "no significant difference between the profiles on Cary till and those on Tazewell till." Of three size fractions (sand, silt, and clay) of calcareous till he found the greatest proportion of total carbonates in the silt fraction. He further found that within these three size fractions there was no significant difference in the distribution of carbonate minerals between the tills of Tazewell and Cary substages.

Some studies have also been made on the use, management, and responsiveness of many of the till-derived soils in northeastern Illinois. Kidder and Lytle (1949) found that good drainage with tile could be obtained in Elliott silt loam by spacing the tile lines 40 feet apart, but the lines needed to be less than 20 feet apart in Bryce silty clay loam and not more than 1 or 2 feet apart in Rowe silty clay. Drainage by tile is not recommended in Rowe and is of questionable value in Bryce. Bartelli and Peters (1959) studied the relationship of soil moisture to certain physical properties of several Illinois soils and found that "available soil moisture was highly correlated with the ⅓-atmosphere percentage but not correlated with the 15-atmosphere percentage." They also concluded that "available moisture was controlled principally by the silt fraction."

While studying the rooting habits of corn on various soil types, Fehrenbacher and Rust (1956) found that many corn roots penetrated to 4 feet or more in Ringwood and Saybrook soils, but few roots were found below 3 feet in Elliott or Clarence. They attributed the shallower rooting in Elliott and Clarence soils "to high bulk density and consequent low aeration in the underlying, unweathered, fine-textured tills that lacked soil structural development" and calculated the available water storage capacity to the depth of rooting in each soil as follows: 9.8 acre-inches in Ringwood; 10.6 acre-inches in Saybrook; 7.1 acre-inches in Elliott; and 6.4 acre-inches in Clarence. Although the results were from only one year's study for each soil, Fehrenbacher and Rust concluded that it was "highly probable that differences in depth of rooting and in available soil moisture in rooting zones account for the wide differences in long-time average corn yields on these soils" (see table on page 24).

DeTurk (1942), reporting on phosphate fertilizer problems, showed that the "loessial soils of northern and central Illinois contain more of the readily available forms of phosphorus than the till-derived

soils" in the northeastern part of the state. Smith (1950) found that crops grown on till-derived Elliott-Ashkum soils at the Joliet soil experiment field produced much larger yield increases from applications of rock phosphate than the same crops grown on loess-derived Muscatine-Sable soils at the Kewanee soil experiment field.

Odell and Rust[1] collected crop-yield and soil-treatment data extending back 10 to 25 or more years from a large number of farmers' fields. After sorting the fields according to soil type or soil association and management practices they studied crop yields under different environmental conditions. On the basis of these data they estimated the yields of corn, soybeans, and oats that could be produced with a "moderately high" level of management. The average yields for some common dark-colored, till-derived soil associations in northeastern Illinois during the 10-year period ending in 1955 were as follows:

Soil association	*Corn*	*Soybeans* (*bushels per acre*)	*Oats*
Clarence-Rowe	61	27	49
Swygert-Bryce	64	26	50
Elliott-Ashkum	66	29	53
Saybrook-Lisbon-Drummer	77	33	66

SOILS STUDIED AND METHODS USED

The extreme variability in the properties of the till and associated outwash sediments of Wisconsin age accounts for the large number of soil series that are recognized in northeastern Illinois. The Gray-Brown Podzolic and Brunizem soils in general have silt loam surfaces or A horizons owing to the thin mantle of loess or windblown silty deposit over most of the area. This thin loessial deposit is responsible for most of the monotype soil series. Some of the soils in the region, however, developed in sandy materials which resulted in a sandy loam surface texture. Most of the Humic-Gley soils have silty clay loam A horizons.

The correlated series and a few uncorrelated series mapped to date in this region are given in the key, in the pocket inside the back cover. This table includes soils with sola developed in till or outwash of various textures, thin loess on till or outwash, and loess 3 to 5 feet thick on till or outwash. Figures 23 through 28 (pages 95-100) show the relationships of the soils studied to parent material, native vegetation, topography, and associated soil series.

The profiles of all 17 soil series listed in Table 1 were examined

[1] Unpublished data.

at several locations. Some were examined many times for specific observations and measurements. In addition, the profiles of these different series from 33 sites were described and sampled in detail for laboratory analyses. These 17 soil series were developed in six different textures of glacial till or in a thin covering of loess and/or local wash material on the till. Horizon samples were taken of 11 profiles of light-colored Gray-Brown Podzolic soils, 13 profiles of dark-colored Brunizem soils, 3 profiles of moderately dark prairie-forest transition soils, i.e., Gray-Brown Podzolic intergrade to Brunizem, and 6 profiles of Humic-Gley soils. The 33 profiles of the 17 series sampled are referred to by number in Table 1. The sampling locations along with profile descriptions are given in Appendix A.

Field methods

A soil survey has been made in each of the 32 counties or portions of counties included in this study (Fig. 1). However, the field work in many of these counties was completed before modern concepts of soil science and current field and laboratory methods were used in soil survey mapping and correlation.

Since 1929 twelve counties in northeastern Illinois have been mapped in the detail necessary to furnish information similar to that provided by the field work in this study. The soil maps of these twelve counties were used extensively in this study although additional information was needed in some of them. These maps indicate with considerable accuracy the following: (1) areas of the six textures of calcareous glacial till of Wisconsin age where the loess cover is thin or absent, (2) areas of water-deposited materials, (3) areas of sandy soils, (4) areas of light-colored Gray-Brown Podzolic soils, (5) areas of dark-colored Brunizem and Humic-Gley soils, and (6) terrace and bottomland soils. Some of these maps also indicate, but to a lesser degree of accuracy, loess less than about 2½ feet, loess between about 2½ and 5 feet, both on till of Wisconsin age, and loess thicker than 5 feet. No distinction is made in texture or age of the till occurring under loess more than 5 feet thick.

Soil maps of the remaining twenty counties or portions of counties were made prior to 1929. These maps were useful for showing areas of light- and dark-colored soils, sandy soils, terrace and bottomland soils, and whether the underlying till was of Illinoian or Wisconsin age. None of the twenty maps, however, shows separations of soils developed in significantly different textures of Wisconsin-age till, soils developed in different thicknesses of loess on Wisconsin till, or soils developed in water-deposited materials on outwash plains.

Reconnaissance field studies were made in all of these latter counties and wherever necessary in the former to discover and record the following: (1) presence or absence of loess and its thickness wherever it could be identified, (2) depth to free carbonates as determined by effervescence with dilute hydrochloric acid, (3) texture of the underlying calcareous till, and (4) slope at site of examination. This last measurement was useful to indicate the comparative depth of leaching on comparable slopes between tills of different textures as well as relative depth of leaching in tills of the same texture but of different geological age. Soil series or soil types were identified at most of the sites. Color of calcareous till, depth to bedrock or other contrasting material, if shallower than about 5 or 6 feet, and topography of the surrounding terrain were also noted.

Field examinations were made with a spade in road cuts, gully banks, or excavations of various kinds, or with a soil auger in fields, forested areas, or along roadsides, wherever suitable sites could be conveniently located. A record was kept by counties of the location (township, range, section, quarter, and 40 and 10 acres) of each examination made, along with as many of the above-listed observations and measurements as could be noted or that applied to the area. Use was also made of U.S. Geological Survey topographic maps. From these field observations and available county soil maps the map of the "Parent Material and Surface Color of Soils in Northeastern Illinois" was prepared. A copy of this map is included in the pocket at the back of this bulletin.

Horizon samples of 17 soil series were collected from 33 locations (see Appendix A). Numerous examinations were made with a soil auger in the area of known occurrence of the soil to be sampled. From these observations the sampling site was chosen at the spot deemed most representative.

A pit was dug at each site and the freshly exposed vertical soil section or profile was carefully examined, divided into horizons, and described. All horizon characteristics of each profile, such as thickness, color, texture, structure, and consistence, were noted and recorded. Other features, such as slope gradient and direction, vegetative cover, depth to carbonates, and character of till, were also recorded.

Most samples were of the full thickness of a horizon as described. However, some horizons were subdivided into sampling layers 2 to 6 inches thick. These were primarily subdivisions of subsoil or B_2 horizons that were greater than about 8 or 10 inches thick. Some A- and B-horizon samples taken by Pearse (1941) were from 2-inch and 3-inch layers.

Samples were taken with a flat spade inserted horizontally at the base of the sampling layer. The spade was lifted out in such a way that a slice of soil material representing the whole layer was obtained. Each sample was then transferred to a labeled cloth bag. In addition to the bulk samples, four to six undisturbed core samples were taken from each major horizon of many of the profiles. These were taken with a sampler such as illustrated by Uhland (1949), except for Profile Nos. 28, 30, 31, 32, and 33, in which sample cores were taken horizontally instead of vertically, and which were 2½ x 3 inches instead of 3 x 3 inches.

Laboratory methods

When the core and bulk samples were received in the laboratory, the undisturbed core samples were weighed to determine moisture content at time of sampling and were then saturated with water for hydraulic-conductivity and capillary- and noncapillary-porosity determinations. They were then oven-dried at 105° C. to determine bulk density. The bulk samples were allowed to air-dry and were then weighed. The soil aggregates were crushed with a wooden roller on a hardwood board to pass a 2 mm. sieve (No. 10 ASTM). The soil material passing through the sieve was placed in ½-gallon glass jars for the various physical, chemical, and mineralogical analyses reported in Appendix C. A small portion of the <2 mm. sample was ground to pass a 100-mesh sieve for organic and inorganic carbon analyses. The material greater than 2 mm. in diameter, consisting of gravel and resistant concretions, was weighed and the percentage of the total sample was determined. Lithology was studied on a number of these coarse-fraction samples.

The procedures used in this laboratory are briefly mentioned in the following paragraphs. Modifications were used in certain instances. These are described in detail in Appendix B.

Particle-size distribution (mechanical analysis) was determined on all samples according to the pipette method outlined by Gieseking (1949). The calcareous horizons were also analyzed by the procedure described by Kilmer and Alexander (1949) with slight modifications (see Appendix B).

Hydraulic conductivity, capillary and noncapillary porosity, and bulk density of each core sample were determined by the methods described by Van Doren and Klingebiel (1949). However, the hydraulic conductivity on a few of the profiles was determined with the constant-head conductivity rack. This method is described by Uhland and O'Neal (1951).

The techniques for determining the ⅓-atmosphere and 15-atmosphere moisture percentages are described by Richards *et al.* (1954). Moisture considered available for plant growth, often referred to as the available moisture range, is the difference in soil moisture content between the upper limit or field capacity (approximately ⅓-atmosphere percentage) and the wilting coefficient (approximately 15-atmosphere percentage).

The total exchangeable bases were determined according to the procedure outlined by Bray (1942a), with minor modifications. Calcium, potassium, and sodium were determined with a Perkin-Elmer flame photometer, using lithium as an internal standard for most of the samples and direct reading on the others. Magnesium was calculated by the difference between total base content obtained and the sum of Ca, K, and Na. Cation-exchange capacity was determined with the flame photometer after the soil was saturated with potassium and then leached with hydrochloric acid.

pH was determined with the Beckman pH meter using a 1:1 soil-water ratio.

On laboratory analyses made prior to 1945, total-carbon determinations were made using the dry-combustion method as outlined by Winters and Smith (1929). Because there is little or no overlap between horizons high in organic carbon and those high in free carbonates in the soils studied, the data are considered comparable to data obtained with other methods subsequent to that date. Since 1945 organic-carbon determinations have been made using one of three methods: (1) the wet-combustion method as outlined by Allison (1935), (2) a modified wet-combustion method (see Appendix B), and (3) a modified carbon-induction method outlined by Jackson (1952). For the calcareous horizons, carbonates were determined by using the Fisher carbon-induction method using the modified procedure described in Appendix B for organic carbon, except that smaller samples of soil were used (approximately 0.2 gm.).

Available potassium and the adsorbed (P_1) and adsorbed plus acid-soluble (P_2) phosphorus were determined by the methods outlined by Bray (1942b, 1945).

Determinations of the kinds of clay minerals were made on the $<2\mu$ material of representative horizons of one profile of each soil series studied. This was done by using potassium- and magnesium-treated clays dried on 1-inch x 3-inch glass slides and analyzed with a General Electric XRD-5 X-ray diffraction unit. Evaluation was according to criteria prepared by a special committee on clay mineralogy of the Soil Science Society of America (1956).

Percentages of heavy minerals were determined on samples that had been cleaned by removal of iron oxides by the Deb (1950) method and then washed with HCl to remove carbonates. Bromoform of specific gravity 2.87 to 2.90 was used as the separating liquid. Heavy minerals in the very fine sand and coarse silt fractions were obtained by a method developed in the Agronomy Department laboratories (see Appendix B).

Individual heavy minerals from the very fine sand fraction were identified and counted. Magnetic minerals were removed with a strong magnet (Franz separator) before mounting in Canada balsam on microscope slides. Approximately 500 to 600 mineral grains per slide were counted (Appendix D). Transects were made across the slides with only the grains intercepted by the cross-hairs being counted.

Because the cleaning and mounting procedures used may have altered or destroyed the grains of some less-resistant minerals and because such cleaning and washing are unnecessary according to some competent mineralogists, a second heavy-mineral grain study was made on a few selected samples omitting these procedures (Table 7, page 55).

The coarse silt (20–50 μ) and very fine sand (50–100 μ) fractions of the samples shown in Table 7 were analyzed quantitatively for zirconium dioxide (ZrO_2). The coarse silt fraction was analyzed for strontium, rubidium, copper, zinc, iron, maganese, and titanium. The analyses were made with a General Electric XRD-5 X-ray spectrograph using a tungsten tube, lithium fluoride crystal, and proportional flow counter operated at 50 kv. and 45 ma. The clay fraction was analyzed for K_2O (Table 6, pages 48 and 49), and for this analysis a helium atmosphere was employed. The percentages of ZrO_2 were based on standards of known ZrO_2 content obtained from the National Bureau of Standards. Potassium percentages of the clays were based on standards of Beavers *et al.* (1955).

CHARACTERISTICS OF PARENT TILL MATERIAL[1]

Marked differences exist in the texture, moisture-holding capacity, permeability, depth of leaching, color, and other properties of the tills of Wisconsin age in northeastern Illinois. These differences are reflected in many soil profile features as well as in the use, management, and productivity of the associated soils.

[1] All samples were obtained in till plains or morainic areas but water may have been an effective sorting agent in the coarse gravelly materials and in some of the very fine clayey materials.

Texture or particle-size distribution

The most important single characteristic of the calcareous till is its extreme range in texture. Field work of the Soil Survey has shown that texture of the till varies from very coarse gravel to clay.[1] This variation is slight in some areas but extreme within short distances in other areas.

Particle-size distribution analyses in this and previous investigations show that, throughout the region studied, the relatively unweathered, calcareous tills range from less than 1 percent to more than 70 percent clay ($<2\mu$), from a low of about 1 percent to a high of about 65 percent silt (2μ–50μ), and from less than 1 percent to about 65 percent sand (50μ–2 mm.). Percentages of the gravel and cobble fraction (>2 mm.) range from none to more than 80 percent (Table 3). These data are based upon weight of the total sample.

If particle-size distribution data of the unweathered tills are arranged in order of decreasing clay content, the content of gravel increases (Fig. 5). Sand increases until the gravel fraction reaches approximately 30 percent and then decreases. Silt increases until the combined gravel and sand reach about 15 to 18 percent and then declines in amount. When arranged in this manner a slight but regular

[1] Clay, silt, sand, and gravel are terms used to denote particles of a distinctive size as well as texture classes dominated by the respective size fraction.

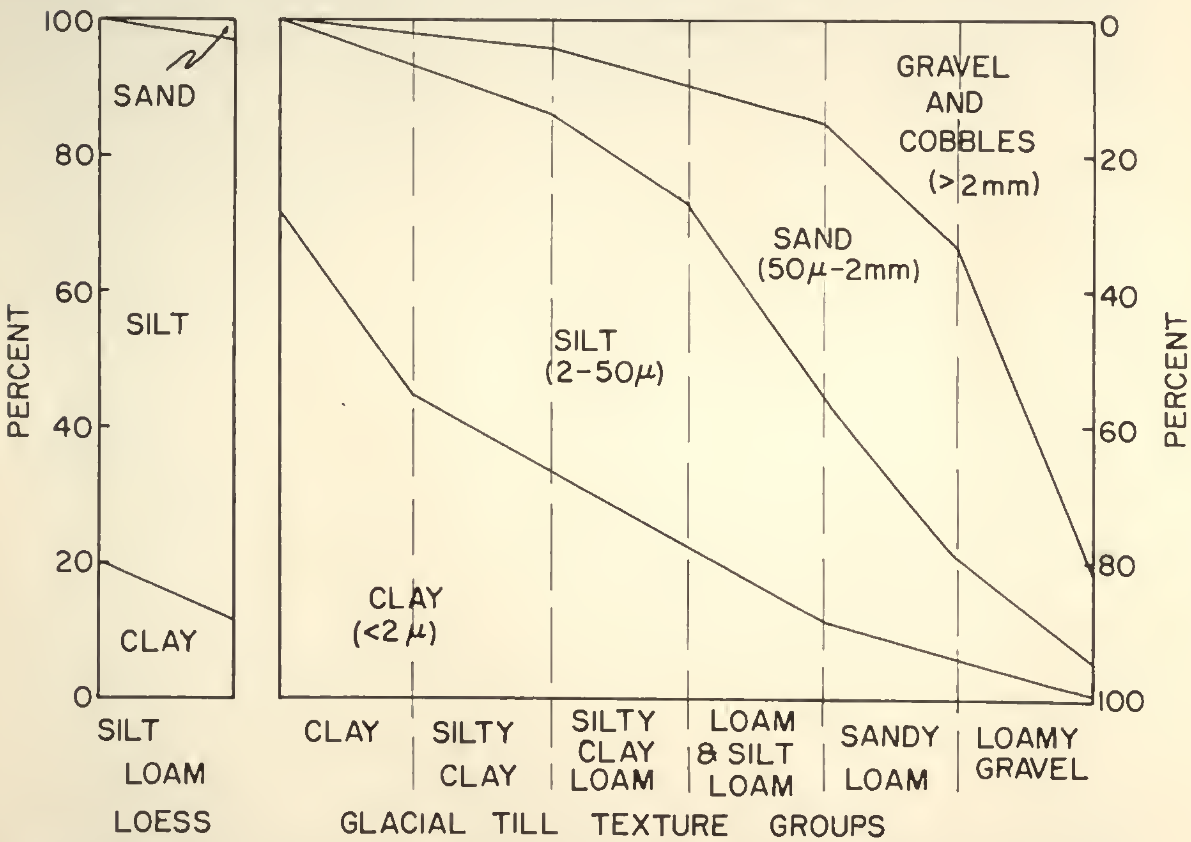
Table 3. — Percentages of Gravel, Sand, Silt, and Clay in the Six Texture Groups of Calcareous Glacial Till in Northeastern Illinois[a]

Texture group of glacial till		Gravel (>2 mm.)	Sand (2 mm.-50μ)	Silt (50μ-2μ)	Clay ($<2\mu$)
		perct.	*perct.*	*perct.*	*perct.*
Loamy gravel.........	Average	62.5	30.9	4.8	1.5
	Range	31.9–82.2	15.5–64.6	1.0–14.4	.3– 7.8
Sandy loam..........	Average	24.7	46.5	23.6	4.2
	Range	14.4–36.3	42.3–51.8	16.0–30.8	2.1– 6.8
Loam and silt loam....	Average	7.5	24.0	46.0	20.7
	Range	4.3–16.2	14.0–39.3	36.5–54.2	14.3–25.5
Silty clay loam.......	Average	4.1	12.0	52.5	31.3
	Range	.1–14.0	3.8–16.3	45.5–65.1	24.2–36.4
Silty clay............	Average	2.8	10.0	47.2	39.7
	Range	.1– 6.7	1.4–15.9	38.9–53.6	34.7–44.9
Clay.................	Average	1.3	4.7	39.3	54.4
	Range	0– 4.4	.4– 9.8	27.4–47.6	44.5–72.1

[a] Data are based on the weights of total material of approximately 200 samples analyzed for this and previous studies by many present and former members of the Soil Survey staff.

variation in distribution of the different particle sizes results. No distinct natural breaks are apparent. However, a selection of textural groupings based on coherence and color (see colored plate facing page 32) in addition to particle-size distribution data helped to establish significant till groups that may consistently be identified, separated, and mapped in the field. This permits valid comparisons of field experiments, such as crop productivity, percolation, and drainage studies among the soils associated with the various till textures.

On the basis of combined field and laboratory evidence, six textural groupings of the calcareous tills were established (Fig. 5). It should be noted that the boundaries of the six till-texture groups do not always

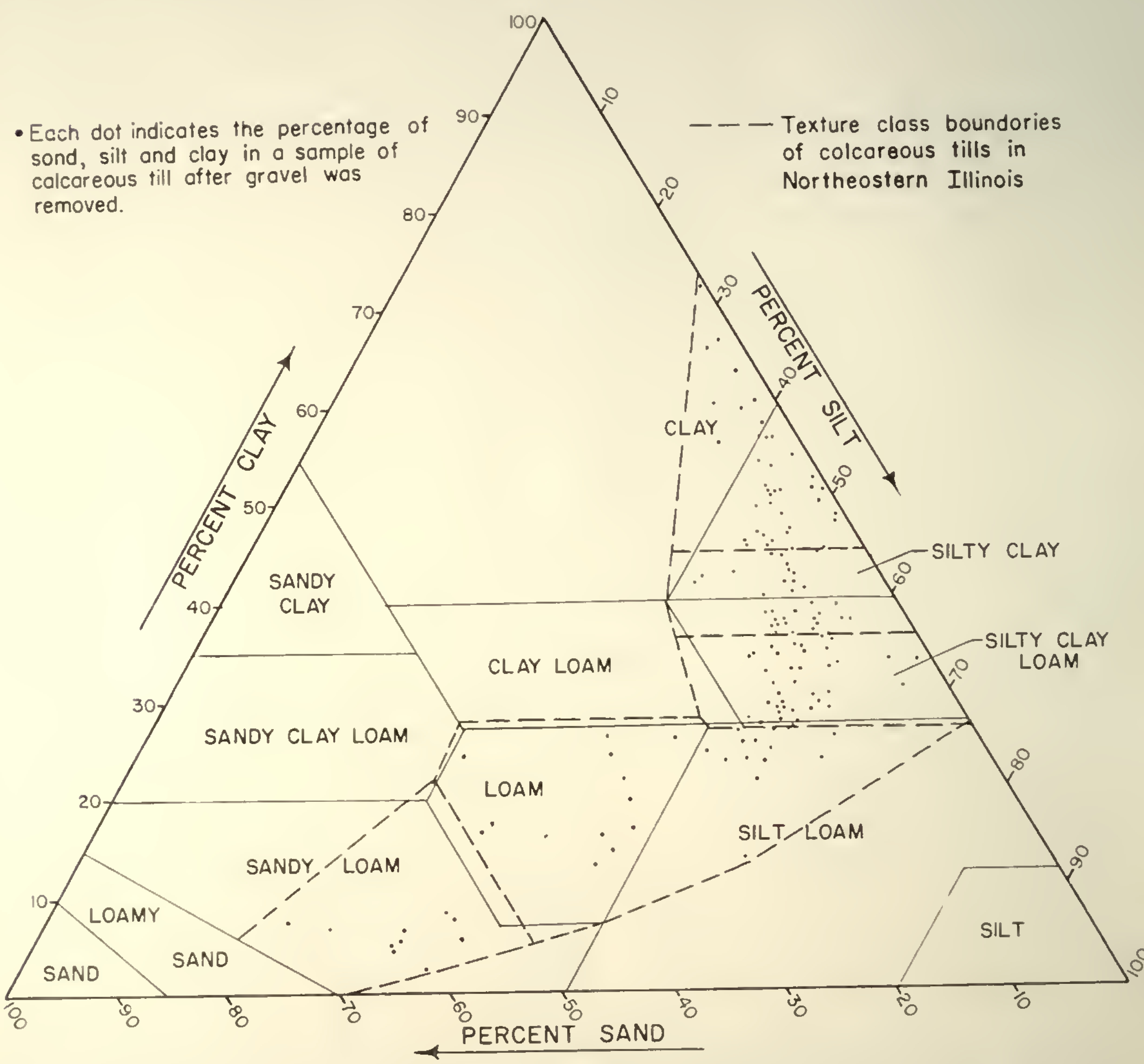


Approximate range in particle-size distribution of calcareous loess and calcareous glacial tills based on the weight of the entire sample, including gravel. (Fig. 5)

correspond to those of the official textural classes on the texture triangle (Fig. 6). For example, the silty clay till-texture group includes the finer portion of the official silty clay loam textural class. These six groups with their range in distribution of the four particle size separates, along with the average of each separate, are given in Table

3. The definition of each till-derived soil series mapped in northeastern Illinois includes a reference to one of these six textures of parent material.

The gravel fraction is lowest in the clay texture group and highest in the loamy gravel group. Increase in average percentage of gravel between adjacent groups is consistent as texture becomes coarser, but



The calcareous tills of northeastern Illinois range in texture from clay to loamy gravel, but gravelly textures cannot be shown on this texture triangle. When classified on a gravel-free basis, texture ranges from sandy loam through loam and silt loam, silty clay loam, and silty clay to clay. Note that the sandier portion of loam is included in the sandy loam texture group and the less clayey portion of clay loam in the loam texture group. The more clayey portion of silty clay loam is included with the silty clay texture group, and the most clayey portion of silty clay is included with the clay texture group. (Fig. 6)

Representative examples of six textures of calcareous glacial till. The range in particle-size distribution is from more than 80 percent gravel with little or no clay to more than 70 percent clay with little or no sand and gravel. Colors range primarily from bright yellowish-brown (10YR 5/4-5/6 to 6/4) in the medium to coarse textures, except that pinkish colors predominate in some areas, through olive-brown (2.5Y 5/4) and grayish-brown (10YR 5/2) in the moderately fine textures to light brownish-gray (2.5Y 6/2 to 10YR 6/2) and light gray (10YR 6/1-7/1) in the finest textures.

COLOR PHOTOGRAPH OF SIX TEXTURES OF CALCAREOUS GLACIAL TILL

overlap in the range occurs among the groups. Gravel is the dominant fraction in the loamy gravel texture. It is of limited importance in sandy loam and of very minor significance in the other four textures.

The sand fraction averages highest in sandy loam texture although the range between samples is widest in loamy gravel. It is lowest in the clay texture group. Sand is of major importance in the sandy loam and loamy gravel textures. It is of limited importance in loam and silt loam texture and of minor significance in silty clay loam, silty clay, and clay textures.

Silt averages highest in silty clay loam, decreasing as texture becomes either coarser or finer. It is of major importance in the loam to silt loam, silty clay loam, and silty clay textures. It is of somewhat limited importance in the sandy loam and clay textures and of minor significance in loamy gravel.

The clay fraction is highest in the clay texture group and is lowest in loamy gravel. It is the dominant fraction in clay and silty clay textures. It becomes progressively less important in silty clay loam, silt loam to loam, sandy loam, and loamy gravel textures. The overlap in range of clay content between adjacent groups is very small, particularly in the fine textures. The amount of clay is the dominant property in distinguishing field textures in the four finer-texture groups. It is of little or no significance in distinguishing the sandy loam or loamy gravel textures.

Because portions of the sola of some soil profiles sampled for this study are formed from loess and are gravel-free, mechanical analyses of the unweathered tills are also reported on a gravel-free basis (see Appendix C). Figure 7 shows the approximate range in particle-size distribution on a gravel-free (material <2 mm.) basis of the six till textures. A comparison of this figure with Fig. 5 shows little or no difference in range of sand, silt, or clay content in the finer-texture groups. In the coarser textures, however, in which the gravel content is high, the sand, silt, and clay percentages are increased. These data do not present a true picture of texture or particle-size distribution in the coarser-texture groups.

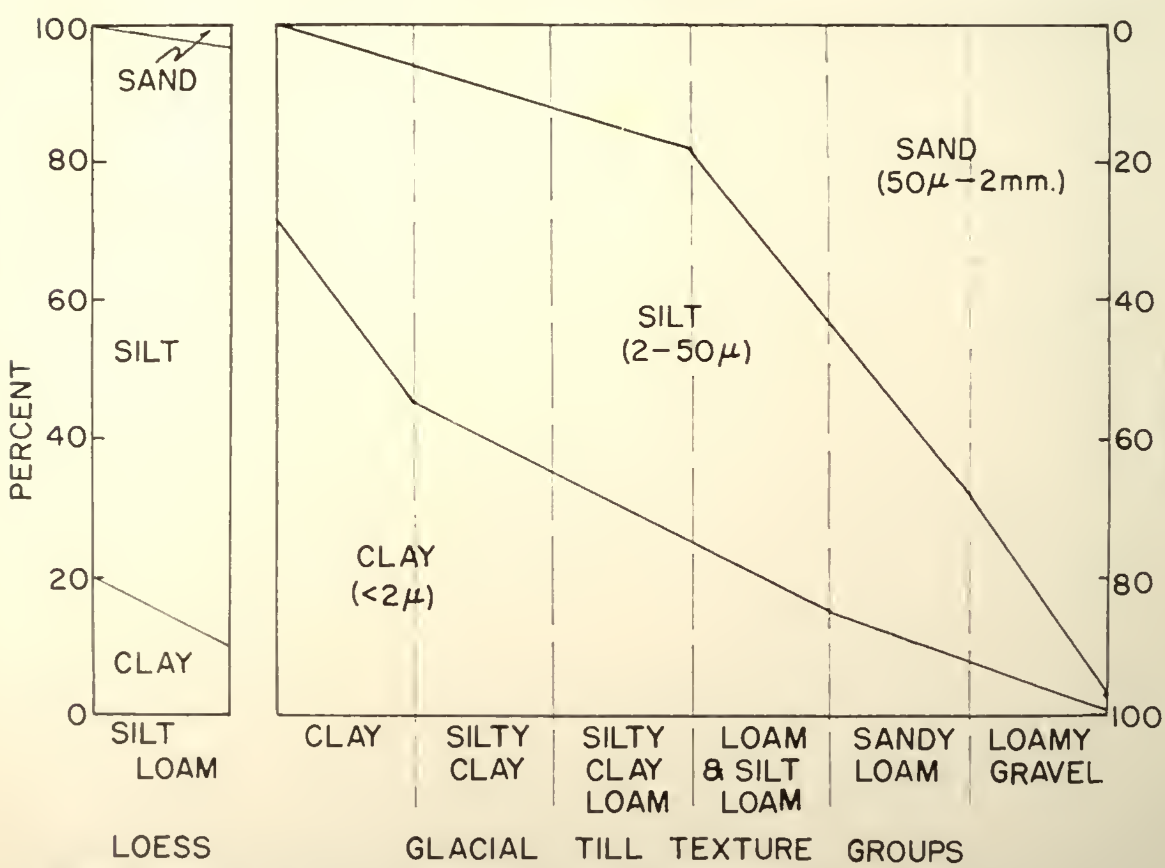
Silt as a distinguishable till texture has not been observed in northeastern Illinois nor has sandy clay, sandy clay loam, or the sandier range of the clay textural class (Fig. 6). Local pockets of sand till and fine sand till occur, but widespread mappable areas have not been found.

Areas of each of the six texture groups of till approximately one square mile or larger are shown on the colored map (in pocket inside

back cover). These areas are delineated without regard to the loess that blankets much of the region.

Areas of loamy gravel material (No. 1 or dark red color on map) occur primarily in the extreme north but with moderately extensive areas along some major streams. Sandy loam till (No. 2 or orange color on map) also occurs primarily in extreme northern Illinois plus one important area in northeastern LaSalle and northwestern Kendall counties. Loam and silt loam till (No. 3 or yellow color on map) is the most extensive. It occurs throughout the north-central, western, and southern portions of the area studied. However, much of this till is covered with 3 or more feet of loess (Fig. 9, page 44).

Silty clay loam till (No. 4 or medium blue on map) is extensive in the central, southeast, and northeast parts of the area studied. It is most extensive in the Cropsey, Chatsworth, and Marseilles moraines and associated till plains south of the Illinois and Kankakee rivers and in the Valparaiso morainic system north of the Kankakee river and east of the Fox river. The largest areas of silty clay material (No. 5 or dark blue on map) are in the Chatsworth and Marseilles moraines,



Approximate range in particle-size distribution of calcareous loess and calcareous tills based on weight of material <2 mm. in diameter (i.e., gravel-free). (Fig. 7)

with smaller areas in the Cropsey, Valparaiso, and Lake Border moraines and elsewhere. Clay-textured material (No. 6 or dark purple on map) occurs primarily in the Chatsworth moraine but with minor areas in Iroquois, Grundy, and Kendall counties.

Moisture-holding capacity

Data in Appendix C show that the water retained at ⅓-atmosphere tension in the unleached tills increases with increasing clay content. The extreme range in the data obtained for this study is from a minimum of 3.7 percent of water by weight of material less than 2 mm. in one sample of loamy gravel till to a maximum of 34.8 percent in one sample of clay till. In these same samples the water held at ⅓-atmosphere tension minus water held at 15-atmosphere tension ranges from 2.2 to 16.5 percent and is assumed to be available for plant growth. Average percentage of available water for each till-texture group calculated by this method (percent by weight of material <2 mm.) is as follows: loamy gravel, 3.5; sandy loam, 6.7; loam and silt loam, 8.7; silty clay loam, 9.2; silty clay, 10.4; and clay, 14.7.

When converted to inches of water per inch of till material (percent by weight of water $\times$ bulk density), the amount of available water that can be held ranges from a low of 0.11 inch in a sample of sandy loam till to a high of 0.24 inch in a sample of clay till. In the silty clay loam till group, data from thirteen samples show a range in capacity to hold available moisture of 0.13 to 0.18 inch per inch of material with an average of 0.16 inch. No data were obtained on loamy gravel till but the nature of the material indicates that its capacity to hold available moisture will be less than 0.10 inch per inch of till.

Field observations indicate that unweathered till in some areas is much more compact than in other areas. This was noted primarily in tills of loam, silt loam, and silty clay loam textures. Because compaction reduces the amount of water held and its rate of movement, the water available to plants under field conditions may be less in some areas than these data indicate. The B horizon of soils in the compacted till areas tends to be less oxidized than in areas of less compact till. Also the B horizons in these areas tend to have a more angular blocky to prismatic structure than in areas of less compact till.

Bulk density

Bulk-density determinations show a range from a low of 1.52 in one sample of partially leached silty clay loam till (Blount, No. 8, Appendix C) to a high of 1.88 in one sample of unleached sandy loam

till (McHenry, No. 5, Appendix C). In general the lowest average bulk density occurs in the till of highest clay content, and the highest bulk density occurs in the till of highest sand content. No bulk-density determinations could be made of loamy gravel till with the method used in this study.

The data in the tables in Appendix C indicate some variations in bulk density of the calcareous till within a single texture group. Some of these variations are due to variable compaction by glacial ice, whereas others seem to be due to partial weathering. In four of the five examples of calcareous silty clay loam till in which an upper layer and lower layer may be compared, the uppermost or partially leached layer has the lower bulk density.

Permeability

The rate of water movement through unweathered till depends primarily on texture and compaction. It is less than ½ inch an hour in a majority of the samples studied according to the method used. It is considerably lower than that of most of the overlying soil horizons (see Appendix C). Medium to coarse textures tend to have higher rates than fine textures but not consistently. One sandy loam (McHenry, No. 5, Appendix C) and two loam (Miami, Nos. 6 and 7, Appendix C) texture samples had measured rates of only 0.1 inch an hour.

Rainfall penetrates loamy gravel till very rapidly but also tends to move through it so rapidly that rock and mineral weathering is slow. Partially weathered limestone pebbles occur within the top few inches of the till in the area studied regardless of the thinness of surficial material. In general the water table is deep and the sola as well as the underlying tills are well oxidized (see color plate facing page 32 and discussion of color, pages 37-38). Areas in which loamy gravel material is at a shallow depth or exposed at the surface are drouthy.

At the other extreme clay-textured till absorbs rainfall very slowly. Downward movement of water is so slow that the soil surface is saturated quickly and runoff is high. Leaching is very slow and limestone particles remain in the top few inches of the till. Soils developed in clay till or where the till is at shallow depths are imperfectly to poorly oxidized even on slopes and ridges. Tile are ineffective and plant roots seldom penetrate more than a few inches into the till.

The tills of loam and silt loam texture, on the other hand, absorb rainfall freely. Excess water moves downward readily to underground outlets but much is retained. Leaching is relatively rapid and few or

no limestone pebbles remain in the upper foot or two of the till, particularly where it is covered by not more than about 2 feet of loess or other medium-textured material. In general, air-and-water relationships are related directly to slope. On upper slopes and high narrow ridges the water table is deep and the soils are well oxidized. On lower slopes and wider ridges, as the topography levels out, the water table is nearer the surface and the soils are moderately well oxidized to imperfectly oxidized. On broad, nearly level areas and in depressions where the water table stood at or above the surface most of each year before being lowered by artificial drainage, the soils are poorly to very poorly oxidized.

Color

Differences in color are also important in characterizing the unweathered tills (see colored plate facing page 32). Color tends to be associated with texture, although the kinds and amounts of certain rocks as well as variations in oxidation are also important.

The overall color of calcareous, well-oxidized loamy gravel till is brown (7.5YR 5/4)[1] to yellowish-brown (10YR 5/4-5/6) but with varicolored pebbles and stones throughout. Minor areas occur in which a high water table prevented oxidation of iron compounds and in these areas the predominant color is dark gray (10YR 4/1).

The color of calcareous sandy loam till in the area studied varies from yellowish-brown (10YR 5/4) to light brown (7.5YR 6/4) to reddish-brown (5YR 5/3-5/4) but also with varicolored pebbles and stones. In a few minor areas where a high water table prevented oxidation of iron, the predominant color is dark gray (10YR 4/1).

In the central and southern parts of the area studied, particularly east of the Fox and Illinois rivers, the color of loam and silt loam textured tills is primarily yellowish-brown (10YR 5/4-5/6) to light yellowish-brown (10YR 6/4). West of the Illinois river and west and north of the Cropsey moraine (Fig. 3) this till is primarily reddish-brown (5YR 4/4 to 2.5YR 4/4), grading in some areas to brown (7.5YR 4/4). A few minor areas of reddish-brown till outcrop east of the Illinois river in Woodford, Marshall, and LaSalle counties but in most parts of this area till of this color is covered with tills of more yellowish and grayish colors.

The silty clay loam calcareous till is predominantly olive-brown (2.5Y 4/4) to light olive-brown (2.5Y 5/4) to light yellowish-brown

[1] All Munsell color notations given in this bulletin are from moderately moist material.

(2.5Y 6/4 to 10YR 6/4), mottled with gray (10YR 6/1) and/or yellowish-brown (10YR 5/4-5/6). In the most strongly oxidized sites the predominant color is yellowish-brown (10YR 5/4) and in the most poorly oxidized areas it is dark grayish-brown (10YR 4/2) to gray (10YR 5/1-6/1).

Calcareous till of silty clay texture is primarily grayish-brown (2.5Y 5/2) to olive-brown (2.5Y 4/3), mottled with light olive-brown (2.5Y 5/4) to light yellowish-brown (10YR 6/4). Streaks of white (10YR 8/1) secondary carbonates are sometimes present.

Calcareous till of clay texture is mostly grayish-brown (2.5Y 5/2) to light olive-gray (5Y 6/2) or gray (10YR 5/1-6/1) with or without some mottles of light olive-brown (2.5Y 5/6) and/or pale brown (10YR 6/3). Streaks of white (10YR 8/1) secondary carbonates are sometimes present.

Carbonate content

All of the unweathered tills of Wisconsin glacial age in northeastern Illinois are calcareous. Data from this study and previous studies show that the calcium carbonate equivalent, i.e., the carbonates of calcium and magnesium expressed in terms of calcium carbonate, varies from a low of 11.4 percent in one sample of clay till to a high of 63.2 percent in one sample of loamy gravel till. These data are from that portion of the material less than 2 mm. in diameter.

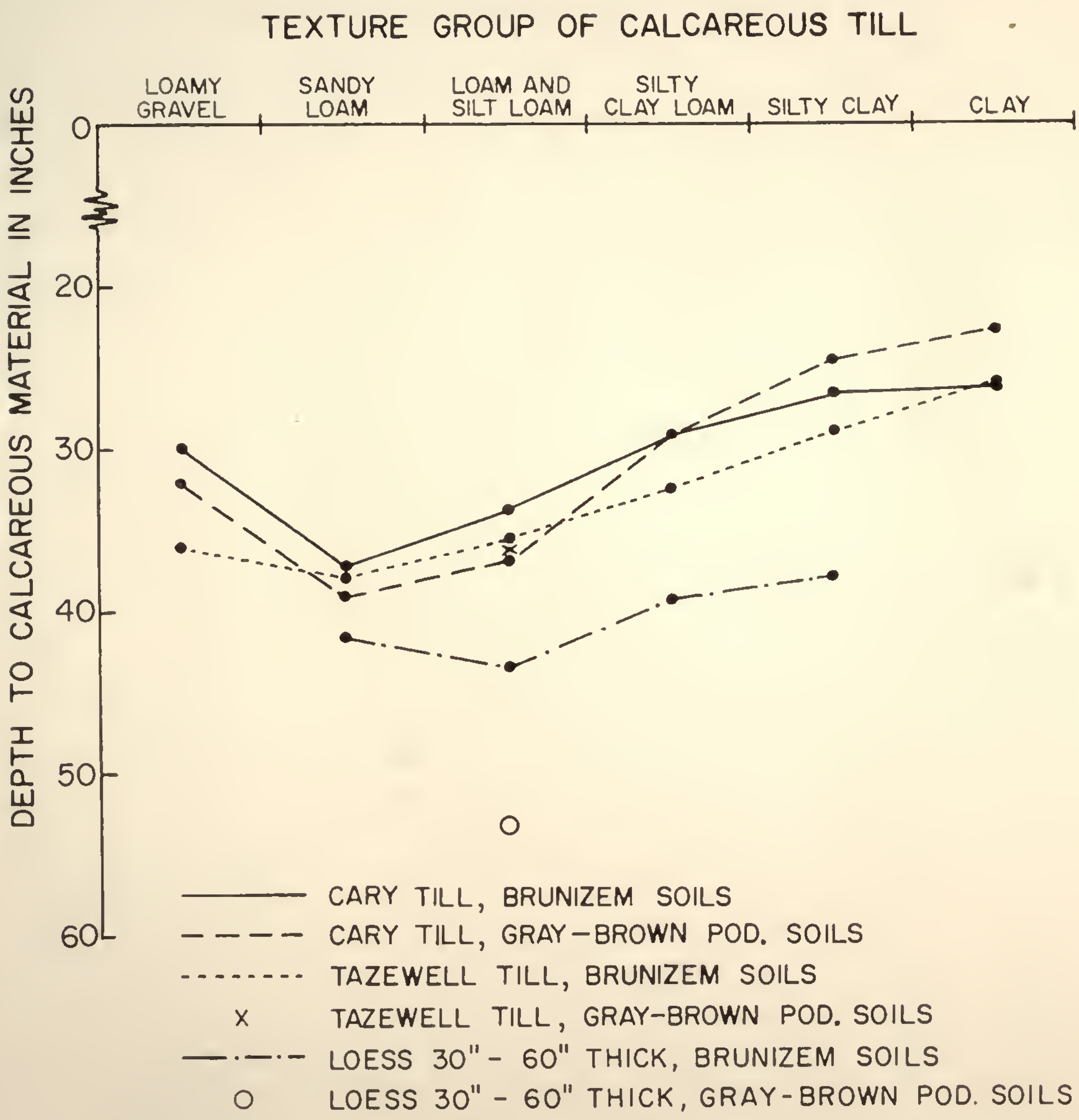
Calcium carbonate equivalents in general average highest in loamy gravel till and lowest in clay till although the range within any one texture group overlaps that of other groups. Average percentages of calcium carbonate equivalent for the six texture groups calculated from data obtained for this and related studies are: loamy gravel 39.8, sandy loam 34.5, loam and silt loam 28.9, silty clay loam 26.9, silty clay 23.0, and clay 22.4. Limited data tend to indicate a slightly higher calcium carbonate equivalent within the same texture group in the northern part of the area studied as compared with the southern part. The differences between the northern and southern parts are probably related to the higher-carbonate Silurian and Ordovician bedrock in the northern part of the area studied as compared with the lower carbonate content of the Pennsylvanian bedrock in the southern part.

Depth of leaching

Depth of leaching in the tills, including associated surficial material, varies widely because of differences in thickness of loess cap, in age of the till sheets, and in composition of the till material. In some portions of the Champaign and associated moraines (Fig. 3) carbonates

are leached to depths of 6 to 8 feet. Parts of these areas are covered with less than 2 to 3 feet of loess and the underlying calcareous till is primarily loam texture. Areas of sandy loam till in Winnebago and neighboring counties are also leached to depths of 8 feet or more. On the Valparaiso and associated moraines, total depth of leaching seldom exceeds 3½ feet.

Within the Cary-age till region in northeastern Illinois (Fig. 3) depth of leaching is related to texture of till. In the Tazewell-age till region, depth of leaching is governed primarily by texture of till and thickness of loess cover (Table 4 and Fig. 8).



Average depth of leaching in Brunizem and Gray-Brown Podzolic soils developed in less than 30 inches of loess on six textures of Cary-age till as compared with similar conditions in Tazewell-age till, and with Peorian loess that is 30 to 60 inches thick over various textures of till. (Fig. 8)

Table 4. — Depth of Leaching in Brunizem and Gray-Brown Podzolic Soils Associated With Different Textures of Till of Tazewell and Cary Glacial Age in Northeastern Illinois

Texture group of till	Depth to free carbonates of calcium[a]																	
	Cary-age till (loess <depth of leaching)						Tazewell-age till (loess <depth of leaching)						Tazewell-age till (loess >depth of leaching)[b]					
	Brunizem			Gray-Brown Podzolic			Brunizem			Gray-Brown Podzolic			Brunizem			Gray-Brown Podzolic		
	No.[c]	Range	Av.[d]	No.[c]	Range	Av.[d]	No.[c]	Range	Av.[d]	No.[c]	Range	Av.[d]	No.[c]	Range	Av.[d]	No.[c]	Range	Av.[d]
		in.	*in.*		*in.*	*in.*		*in.*	*in.*		*in.*	*in.*		*in.*	*in.*		*in.*	*in.*
Loamy gravel......	15	18–41	29.7±6.1	6	24–34	32.0±4.0	7	23–43	36.3±6.8	2	.....	....	1	.....	....	..	.....	....
Sandy loam.......	20	26–47	37.2±5.6	12	28–50	39.0±6.5	5	31–45	37.8±5.9	2	.....	....	13	38–54	41.3±2.6	1	.....	....
Loam and silt loam.	39	24–40	33.6±5.3	3	34–42	36.7±4.6	67	22–56	35.5±5.8	26	30–42	36.1±3.4	102	25–60	43.4±6.8	5	41–60	53.0±8.3
Silty clay loam.....	52	20–39	29.2±4.9	19	21–36	29.2±4.6	76	22–49	32.4±5.2	1	.....	....	10	35–45	39.2±3.8	..	.....	....
Silty clay.........	29	20–36	26.6±3.3	4	22–28	24.5±2.6	6	24–35	28.7±4.1	1	.....	....	9	30–50	37.7±5.2	..	.....	....
Clay.............	4	21–36	26.2±6.6	3	20–24	22.7±2.2	4	22–32	25.8±4.5	..	.....	....	..	.....	....	..	.....	....

[a] Depth to free carbonates is not given where less than three observations were recorded.
[b] No data are included for locations where the loess is thicker than 60 inches.
[c] Number of observations.
[d] The standard deviation of individual observations about each average is indicated after the average.

Average depth to free carbonates in Cary-age till is greatest in sandy loam (about 38 inches) and least in till of clay texture (about 24 inches). This difference is due to differences in permeability, sandy loam till being rapidly permeable and clay till being nearly impermeable. Loam, silty clay loam, and silty clay textured tills, respectively, range between sandy loam and clay in depth of leaching (Fig. 8). Areas of loamy gravel till are usually leached somewhat less deeply than sandy loam till, probably because of extremely rapid permeability and low water-holding capacity as well as the large average size of rock fragments. All depth of leaching measurements were made on uneroded slopes ranging between 1 and 4 percent.

In areas of post-Bloomington Tazewell till, where surficial loess is less than 2 feet thick, the total depth of leaching averages slightly greater than in the Cary-age till (Fig. 8) but overlap is considerable and the differences may not be significant. Carbonates leach more rapidly from loess than from most tills (Fig. 8) and the few added inches of loess in Tazewell areas may account for the difference.

Pebble lithology

Most of the various kinds of rocks found in the tills of northeastern Illinois occur in all of the till texture groups but in variable proportions. Table 5 shows the average percentages of the kinds of rocks common to the gravel fraction in five of the six textures of calcareous

Table 5. — Lithological Composition of the Gravel Fraction of the Texture Groups of Calcareous Glacial Till in Northeastern Illinois

Kinds of rocks in the gravel fraction (>2 mm.)	Texture group of glacial till					
	Loamy gravel	Sandy loam	Loam and silt loam	Silty clay loam	Silty clay	Clay
	perct.	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*
Dolomite and limestone......	77.7	70.3	([a])	30.9	28.4	60.2
Sandstone and siltstone......	2.2	3.7	([a])	52.5	58.3	23.1
Shale......................	0.2	0.1	([a])	6.5	9.7	12.3
Igneous and metamorphic						
Fine-grained..............	8.3	10.2	([a])	2.0	0.1	0.0
Coarse-grained............	7.6	10.0	([a])	1.1	0.9	3.7
Chert, flint, and quartz......	4.0	5.8	([a])	7.0	2.6	0.7
Average percentage of gravel fraction in samples.....	62.5	24.7	7.5	4.1	2.8	1.3

[a] Data on lithology of the gravel fraction of till of loam and silt loam texture are too meager to include. Stauffer (1935) presented data from one sampling site. In his sample shale, flint, and chert were high and sandstone low in relation to the percentages of these pebbles in the five other texture groups.

till. Note that the percentage of gravel is low except in the two coarser textures.

Dolomite and limestone are important rocks in all textures of till. They were the predominant rocks in the gravel fraction of most of the samples but averaged proportionately less in the silty clay loam and silty clay texture groups. Dolomite fragments tended to predominate over limestone in those samples in which the separation was made.

Sandstone and siltstone were not determined separately. Combined, they make up a large portion of the gravel fraction of the fine-textured tills. Shale also constitutes a larger proportion of the gravel fraction in the fine textures compared with the coarser tills, whereas igneous and metamorphic rocks make up a larger proportion of the gravels in the coarse-textured tills. Chert, flint, and mineral quartz fragments, although of minor importance, are more evenly distributed among the various texture groups than are other rocks, although they tend to occur less frequently in the finer textures.

LOESS

Loess is important as a soil parent material in northeastern Illinois. However, it is included only as a minor part of this study. More detailed studies of loess and loessial soils are in progress.

In the southern and western parts of the area studied a layer of loess of variable thickness covers all till materials of Tazewell (early Woodfordian) age or older, except where removed by erosion. This loess, known as Peorian (or Peoria, Fig. 4), is a multiple loess of middle to late Wisconsin or post-Farmdale time.

The earliest Peorian (Morton) loess is not recognizable from the later Peorian (Richland) loess except where it occurs beneath Shelbyville till or outwash. Likewise, Tazewell, Cary, and Mankato loesses (Richland loess) occurring beyond till or outwash deposits of Tazewell (early Woodfordian) age are not separable by presently known methods of field observations and laboratory techniques. The source of Peorian loess in the area studied, especially the silt fraction, was primarily Mississippi and Illinois river valley-train materials. The montmorillonitic clay fraction may have come from more distant sources, according to Beavers (1957).

In Illinois, Peorian loess is thickest on the major river bluffs and thins away from them. However, this thinning has been influenced by successive Tazewell and Cary (Woodfordian) glacial advances. In some places on the Shelbyville and Bloomington till plains in the area

studied, Peorian loess of Tazewell and/or later (Woodfordian) age is more than 10 feet thick. In other places it is less than 2 feet thick. In general it thins eastward; below the big bend of the Illinois river it also thins westward. Westward thinning from the Illinois river valley is relatively more abrupt as compared with the eastward thinning.

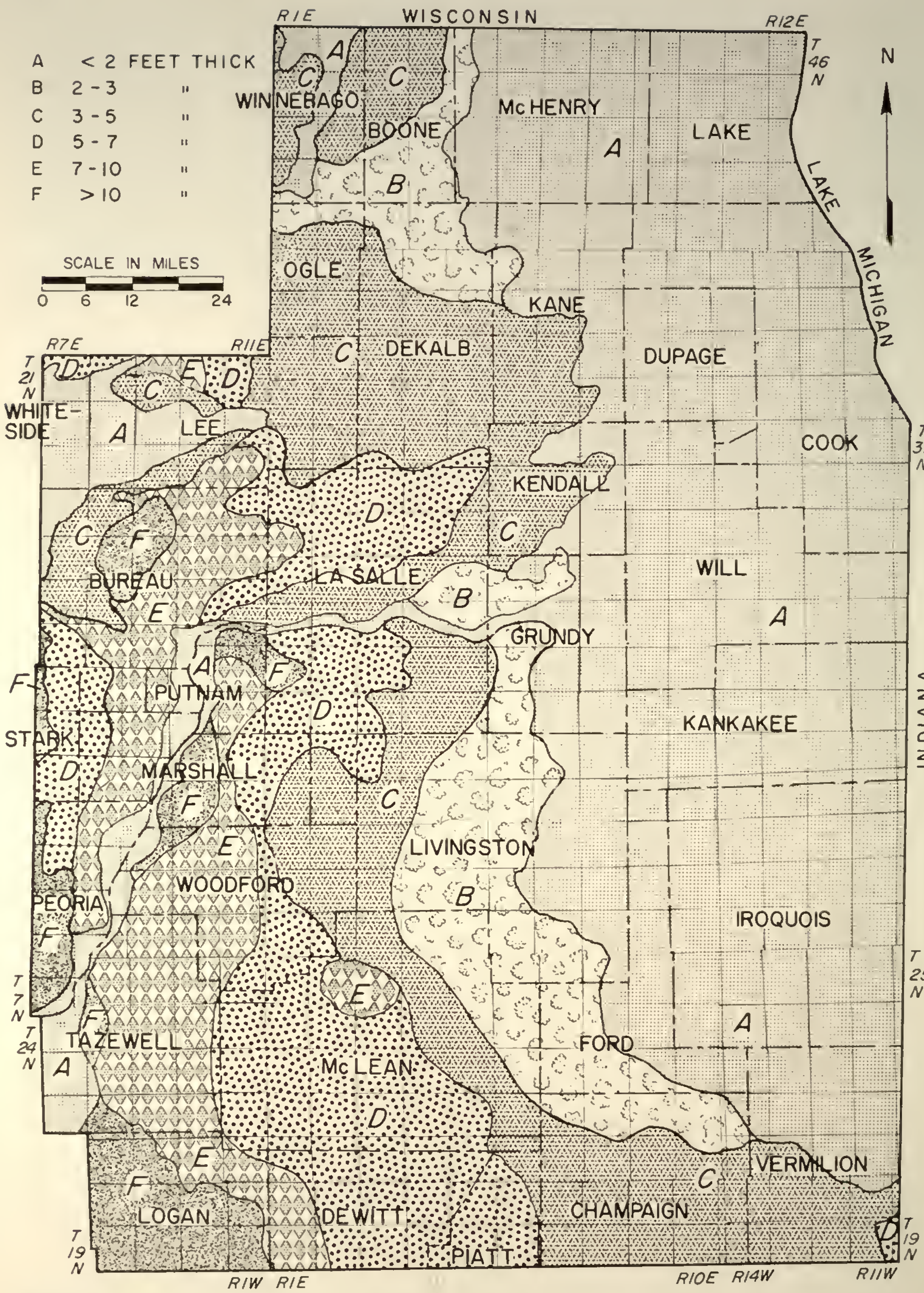
Within the Minooka-Iroquois and later till plains the loess of Cary (late Woodfordian) and/or later age is nowhere thicker than about 2 feet except for minor areas, and averages mostly less than 1 foot. In this till region some silty wind-deposited material of local origin may be present.

Although loess of Mankato and/or Valderan age cannot as yet be separated from loess of Tazewell and Cary (Woodfordian) age, little or no Mankato loess is believed present in the area studied, particularly the Cary-till portion. Some loess of Mankato age, though not definitely identifiable, is more apt to be present in the northwestern portion of the area studied than in the southern or eastern portions. The source of loess for the northwestern portion was more probably the Mississippi valley or local outwash areas rather than the Illinois valley because (1) general loess-depositing winds blew from the west and northwest and (2) little Mankato- or Valderan-age water-deposited material, except some from glacial Lake Chicago, is known to have accumulated in the Illinois river valley to serve as a source of loess.

Figure 9 shows areas in which Peorian loess, as measured on slopes of 1 to 4 percent, is more than 10 feet thick, 10 to 7 feet thick, 7 to 5 feet thick, 5 to 3 feet thick, 3 to 2 feet thick, and less than 2 feet thick. Small areas of thin or no loess occur on steep slopes within all of these delineations. However, only in area A on the map and some of the sloping portions of areas B and C does loess form less than about one-half of the solum in the normally developed Gray-Brown Podzolic and Brunizem soils. In some of the Humic-Gley soils of areas A, water-reworked loess may be thicker than 2 feet.

Of the 27 Gray-Brown Podzolic, Intergrade, and Brunizem profiles sampled for this study, 24 were located in area A in Fig. 9. One of these (McHenry, No. 4) had a possible loess cover thicker than 2 feet. The three remaining profiles were located in area B and of these only one (Saybrook, No. 19) was described with a cover of loess thicker than 2 feet.

Regardless of the absence of positive field identification of loess, the fact that most of these soils had silt loam A horizons suggests the presence of several inches of loess throughout the region.



Major areas in northeastern Illinois covered by various thicknesses of loess as measured on slopes ranging between 1- and 4-percent gradient. (Fig. 9)

ENGINEERING PROPERTIES

The use that may be made of earth materials from different soil areas often varies greatly for engineering purposes. Material from one area may be suitable for certain purposes but unsuited to others. Indiscriminate mixing of suitable materials with unsuitable materials will often result in an unusable mixture. This is especially true in northeastern Illinois.

Odell *et al.* (1960) found that engineering properties such as liquid limit, plastic limit, and plasticity index were very closely related to other properties, such as the content of clay and organic matter and the kind of clay in both till-derived and loessial soils in Illinois. Liquid limit is defined as that moisture content (percent moisture by weight on oven-dry basis) at which the soil passes from the plastic to the liquid state, or at which the soil will just begin to flow when jarred slightly. The plastic limit is defined as that moisture content at which cohesive soils pass from the semisolid to the plastic state. It is the lowest moisture content (percent moisture by weight on oven-dry basis) at which a soil can be rolled by hand into a thread ⅛ inch in diameter without crumbling. The liquid-limit and plastic-limit tests indicate the range in moisture over which a soil is in the plastic state of consistency. This numerical difference between the liquid and the plastic limit is known as the plasticity index.

Appendix E on page 154 includes data on the liquid limit, plastic limit, and plasticity index for approximately one-half of the soil profiles included in this study.

Calcareous glacial till

Glacial till of loamy gravel texture is nonplastic. It is composed of rock fragments too coarse to flow when saturated with water. Insufficient cohesion exists between the rock fragments for the material to exhibit plastic tendencies.

Till of sandy loam texture will hold water up to approximately 15 percent of its oven-dry weight before flowing, and has a moisture range of only about 1 or 2 percent over which it behaves as a plastic body. Tills of the loam to silt loam, silty clay loam, silty clay, and clay texture groups retain increasing amounts of water from about 24 to 54 percent, respectively, as the clay content increases. The plasticity index also varies in a similar manner from a range in moisture of about 8 to 30 percent, respectively. The relationship among the till groups is indi-

cated in the following table, which shows the average liquid limit and plasticity index for the samples analyzed:

	Loamy gravel till	*Sandy loam till*[a]	*Loam to silt loam till*	*Silty clay loam till*	*Silty clay till*	*Clay till*
Average liquid limit	N.P.[b]	15.6	25.9	35.8	40.7	48.1
Average plasticity index	N.P.	1.4	9.4	16.1	21.6	25.5

[a] Data for one sample only; all others are averages of two or more samples.
[b] Nonplastic material.

Loamy gravel till is loose and easy to move with earth-moving machinery. It is excellent for road fill and subgrade material and for use as footings for structures. It is poor material for dikes, levees, or dams.

At the other extreme, clay till is highly plastic and has a liquid limit of approximately 50 percent. Proper compaction is usually difficult because the water content is often above the optimum for good workability. Clay till is poor to fair foundation material for heavy structures, depending on its natural water content and susceptibility to moisture changes. In general it is not suitable for subgrade material. It has poor to fair stability in embankments. It is well suited for dikes and dams where it is kept partially moist by impounded water. This material is poor for levees and terraces where alternate wetting and drying causes large cracks to form across such structures.

The engineering properties of the other four textural groups of tills are arrayed between those of loamy gravel and clay till. Areas in which to prospect for deposits of each of the till materials are shown on the colored map (in pocket inside back cover).

Other soil horizons

Data in Appendix E show that either the A_1 or the B_2 horizon of each profile studied has the highest liquid limit. Other data show that the A_1 horizons are highest in organic matter (organic carbon $\times$ 1.724), and the B_2 horizons are highest in clay within their respective profiles. The liquid limit is lowest in the A_2 horizon for those profiles having an A_2.

In general, the liquid-limit values increase as the clay content increases, although not in a regular manner. They also tend to increase as the organic matter increases. Thus some of the highest liquid-limit values occur in those soil horizons that are high in both organic matter

and clay. Conversely some of the lowest values are found in those horizons relatively low in both, although not necessarily lowest in either one. Some average values of the Gray-Brown Podzolic soils indicate more clearly this relationship of liquid limit and plasticity index to content of organic matter and clay, as shown in the following table:

	A_1 *horizon*	A_2 *horizon*	B_2 *horizon*
Average organic-matter content, percent....	5.0	1.2	1.0
Average clay content, percent............	17.5	20.3	43.7
Average liquid limit......................	40.3	26.7	46.4
Average plasticity index..................	9.8	6.4	24.2

A_1 horizon material in all soils studied is high in organic matter and medium- to fine-textured. It is moderately to highly plastic and, therefore, is not suitable for subgrade material or as foundation material for heavy structures. This material is usually excellent for topdressing embankments.

Silty A_2 horizon material from the Gray-Brown Podzolic soils and those intergrading to Brunizem is low in organic matter and has low or slight plasticity. It may be moved easily but is only fair to poor foundation material. It is unsuitable subgrade material with generally poor compaction characteristics and poor stability in embankments. It provides fair material for low dikes, levees, and terraces, but is easily eroded by running water.

B_2 material includes much clay and is plastic throughout a wide range of moisture. It has the highest maximum potential compaction and the greatest resistance to rupture. It is difficult to move, but provides stable embankment material. The B_2 horizon is usually fair for foundation material but poor as subgrade material. It is desirable material for dikes and dams where kept moist by impounded water. It is less suitable for levees and terraces where alternate wetting and drying and resultant swelling and shrinking may cause formation of cracks across such structures.

Special engineering problems are associated with the Humic-Gley soils because of their poor drainage. They contain more organic matter, clay, and montmorillonite in the A and B horizons than associated Brunizem and Gray-Brown Podzolic soils and are more highly plastic. They are usually subject to distinct settling in embankments and provide poor subgrade and foundation material.

With the use of large power-driven machinery usually little attempt is made to separate soil materials into horizons as discussed here. However, where feasible or where conditions warrant, such separations may prove desirable.

MINERALOGY

To more fully characterize the tills and related soils in northeastern Illinois, various mineralogical analyses were made on the A_1, B_2, and C horizons of one profile of each soil series studied, except for Frankfort. In addition, analyses were made on the A_2 horizon of those profiles in which such a horizon occurred.

Clay minerals

Data on the relative amounts of the major clay mineral types are shown in Table 6. In addition to those indicated, small amounts of kaolinite are doubtless present in most of the samples, as well as interstratified layer silicates, feldspars, quartz, and amorphous materials. Therefore the authors feel that indicating the major clay mineral types in relative amounts is a more realistic approach rather than giving precise percentage values.

The X-ray spectrometer tracings and chemical data show that the principal clay minerals in the soils analyzed in this study are illite, montmorillonite, vermiculite, and chlorite. With the exception of chlorite, these are 2:1 lattice clays in which the general unit cell framework is two layers of silica tetrahedra with an aluminum octahedra

Table 6. — Clay Mineralogy of the Major Horizons of Selected Soils in Northeastern Illinois

Profile No. and soil type	Horizon	Lab. No.	Relative amounts[a] of				K_2O
			Illite	Montmorillonite	Chlorite	Vermiculite	
							perct.
No. 1, Fox silt loam......	A_1	17746	M	S	T	S	1.94
	A_2	17747	S	M	T	S	1.75
	B_2	17750	S	L	T	S	1.45
	C_2	17753	S	S	T	M	1.90
No. 4, McHenry silt loam..	A_1	17768	M	T	S	S	1.92
	A_2	17769	S	S	S	S	1.82
	B_{22}	17772	S	L	T	S	1.74
	C	17774	M	S	S	S	....
No. 6, Miami silt loam....	A_1	17731	M	T	S	S	3.04
	A_{22}	17733	M	S	S	T	3.06
	B_2	17736	M	S	T	S	3.45
	C_2	17739	L	O	T	T	4.82

(Table 6 continued on next page)

[a] Symbols used to indicate relative amounts of clay minerals are: L = large amount (60-100 percent), M = moderate amount (35-60 percent), S = slight amount (15-35 percent), T = trace (5-15 percent), and O = none or amount too small to identify.

Table 6 (Concluded)

Profile No. and soil type	Horizon	Lab. No.	Relative amounts[a] of				K_2O
			Illite	Montmorillonite	Chlorite	Vermiculite	
							perct.
No. 9, Blount silt loam...	A_p	17520	L	T	S	T	3.66
	A_2	17521	L	T	T	T	3.45
	B_{22}	17524	M	S	T	S	4.08
	C_2	17527	L	O	S	T	5.04
No. 10, Eylar silt loam....	A_{11}	17760	L	O	S	O	3.70
	A_2	17762	L	T	S	T	3.79
	B_2	17764	L	T	T	S	4.55
	C_1	17766	L	O	T	T	4.85
No. 11, Eylar silt loam....	A_1	17754	M	T	T	S	3.45
	A_2	17755	M	T	T	S	3.62
	B_2	17757	M	T	T	S	4.65
	C_2	17759	L	O	T	S	5.55
No. 16, Warsaw silt loam..	A_1	17612	M	M	T	T	2.13
	B_2	17616	M	M	T	T	2.05
	C	17619	M	S	T	T	3.78
No. 17, Ringwood silt loam	A_1	17595	M	S	T	S	2.36
	B_2	17599	M	S	T	S	2.58
	C	17602	L	T	S	O	4.58
No. 19, Saybrook silt loam	A_1	17775	M	M	O	T	2.45
	B_2	17778	S	L	T	T	1.57
	C	17780	L	T	T	O	5.78
No. 22, Elliott silt loam...	A_{11}	17504	L	T	O	T	4.05
	B_{22}	17508	L	T	T	S	4.03
	C	17511	L	T	T	T	4.72
No. 24, Swygert silt loam..	A_{11}	17790	M	S	T	S	3.23
	B_{22}	17794	L	T	T	S	4.35
	C_2	17797	L	O	T	T	5.30
No. 26, Clarence silt loam to silty clay loam..	A_1	17740	L	T	T	S	3.55
	B_{22}	17743	L	T	T	S	4.80
	C_2	17745	L	T	T	S	5.86
No. 29, Dummer silty clay loam............	A_{11}	17781	S	M	T	T	2.60
	B_{21}	17784	S	L	T	T	4.28
	D	17789	L	S	T	T	5.57
No. 30, Ashkum silty clay loam............	A_1	16490	L	S	T	T	3.50
	B_1	16496	S	L	T	T	3.20
	C	16506	L	O	T	T	5.85
No. 31, Bryce silty clay...	A_1	16473	M	S	S	S	3.86
	B_1	16479	S	M	T	T	3.33
	C_2	16488	L	O	S	T	5.39
No. 33, Rowe silty clay loam to silty clay..	A_1	16455	L	T	T	T	4.16
	B_{21}	16461	S	M	T	T	3.75
	C_2	16471	L	O	S	T	5.42

[a] Symbols used to indicate relative amounts of clay minerals are: L = large amount (60-100 percent), M = moderate amount (35-60 percent), S = slight amount (15-35 percent), T = trace (5-15 percent), and O = none or amount too small to identify.

layer between. They differ in the kind and amount of isomorphous substitution and the nature of the bonding between the unit cells. Chlorite consists of alternate mica-like and brucite-like layers with substitution of aluminum for silicon in the mica-like layer.

Thorp, Cady, and Gamble (1959), working with samples of Miami silt loam from Wayne county, Indiana, found that montmorillonite, vermiculite, illite, and kaolinite were present in all horizons. Illite was the dominant clay mineral in the C horizon, but montmorillonite was dominant in the horizons of clay accumulation, i.e. B_{21}, B_{22}, and B_3–C_1. They suggest that "much of the clay which has moved and accumulated in the B horizon is montmorillonite; its particle-size is small; it is physically and chemically active, being capable of swelling and of forming complexes with organic compounds."

Calcareous till. In the calcareous till, illite is the most important clay mineral in nearly all of the samples analyzed. It was identified by the presence of a 10Å spacing which remains essentially unchanged on heating to 500° C. or by solvation with ethylene glycol. It may be described as a 2:1 lattice clay with potassium as the binding ion. It is relatively nonexpanding, has a high content of potassium (6-10 percent), and has a moderately high cation-exchange capacity.

Chlorite occurs in slight to trace amounts in all of the calcareous tills studied. It was identified by the persistence of a 14Å basal spacing that was little affected by heating to 500° C., solvation, or cation saturation. Chlorite has low swelling properties and has a moderately high cation-exchange capacity.

Vermiculite was found in 14 of the 16 calcareous till samples studied; in 13 of them it occurred in slight to trace amounts. It was identified by the persistence of a 14Å basal spacing when saturated with magnesium and treated with a slight excess of ethylene glycol, but which decreased to 10Å upon heating to 500° C. Vermiculite has magnesium as the binding ion between the unit cells. It has limited swelling properties, i.e., intermediate between illite and montmorillonite. It has a high cation-exchange capacity, probably as great as montmorillonite or greater.

No montmorillonite was found in 8 of the 16 samples of clay from the various calcareous tills, and only traces to slight amounts were found in the remaining 8. Of these 8 latter samples, 6 were from till of loam or coarser texture and only 2 were from the finer-textured tills. All of the 8 samples containing no montmorillonite were from till of loam or finer texture. The possibility of the montmorillonitic

clay being eluviated from the overlying loess-derived A and B horizons into the coarse-textured C horizons should be considered.

Montmorillonite was identified by the presence of 17Å to 18Å basal diffraction spacing when completely solvated by ethylene glycol and saturated with a divalent cation (i.e., Mg). It is an expanding type clay mineral that is capable of holding large amounts of water, plant nutrients, and organic matter. It has approximately a 25-percent isomorphous replacement of magnesium for aluminum in the octahedral layer. Montmorillonite has high swelling properties and a high cation-exchange capacity.

B_2 horizon. Data in Table 6 show that illite is the most important clay mineral in the B_2 horizon of 8 of the 16 samples. Montmorillonite is the most important clay mineral in seven B_2 samples and in one sample (Profile No. 16, Warsaw) illite and montmorillonite are about equally important. Some vermiculite and chlorite were found in all sixteen B_2 horizon clay samples studied, but only in trace to slight amounts.

A comparison of these data with the field descriptions shows that of the 8 cases in which illite predominates 7 were classed in the field as till. And of the 7 cases in which montmorillonite predominates 6 were classed as probable loess. Thus the evidence strongly indicates that in this region montmorillonite is the predominant clay mineral in loess and illite the predominant clay mineral in till of Wisconsin age. This agrees with the conclusions reached by Beavers *et al.* (1955).

A_2 horizon. Of the 6 A_2 horizon samples, 2 were high in illite, 2 were medium, and 2 had slight amounts. The content of illite tended to increase with the increase of clay in the underlying till but too few samples were studied to imply that this is always true. It tended to approximate the amounts present in the B_2 horizons of the same profiles but averaged somewhat less than that in the unweathered tills.

No A_2 horizon clay samples were high in montmorillonite and only one contained a moderate amount. Two had slight amounts and three contained only trace amounts. There seemed to be a trend toward reduced amounts of montmorillonitic clay mineral as the clay content in the underlying till increased. This suggests that the A_2 horizons of the Gray-Brown Podzolic soils studied, particularly those associated with the finer textures of till, were formed primarily in till but perhaps mixed with some loess.

Chlorite and vermiculite were found in all A_2 horizons studied, but only in trace to slight amounts.

A_1 horizon. Illite is the most important clay mineral in the A_1 horizons of 13 of the 16 samples studied. In two (Warsaw, No. 16, and Saybrook, No. 19), the content of montmorillonite is approximately equal to that of illite, and in only one (Drummer, No. 29) is montmorillonite higher. Again the trend seems to be toward an increased amount of illite and a reduced amount of montmorillonite as the clay content of the underlying till increases, but the trend is not always consistent. This also tends to indicate that these soils are developed primarily in till or till-derived sediments but with some surficial loess.

Chlorite and vermiculite were found in a majority of the A_1 horizons, but in not more than slight amounts.

Potassium content. Table 6 also shows the percentage of K_2O in the $<2\mu$ clay material of these soils. Because potassium is an integral part of the illite structure and not of the other clay minerals, a higher percentage of K_2O is indicative of a higher percentage of illite.

All the clay samples from till, except those from loamy gravel and sandy loam, have high contents of K_2O and large amounts of illite. Those soils with a recognizable covering of loess (e.g., Saybrook, No. 19) show 1.57 to 2.45 percent of K_2O in the upper horizons as compared with 5.78 percent of K_2O in the till below.

Heavy minerals

Weight analyses of sand and coarse silt. The weights of heavy minerals (>2.87 sp. gr.) in percentages for coarse silt (20-50μ) and various sand-size fractions are given in Appendix D (pages 150-151). Weights are of cleaned and washed samples as described in Appendix B.

No significant differences in heavy-mineral content are apparent among the various horizons for profiles numbered 4, 6, 9, 17, 19, 22, and 24. However, considerable variation is evident in profiles numbered 1, 10, 11, 16, 26, 28, 29, 30, 31, and 33; in some of these profiles the calcareous tills were highest in heavy-mineral content whereas in others they were lowest. In profile No. 13 a marked uniformity in heavy-mineral content exists among all horizons except the C. No consistent difference between till and loess as soil parent materials is indicated by these heavy-mineral weight analyses.

In most of the horizons a minimum percentage of heavy minerals occurs in the medium sand fraction (0.25-0.50 mm.). Higher percentages in the coarser fractions may indicate that heavy-mineral grains larger than 0.50 mm. in diameter represent combinations of several minerals rather than grains of single minerals. Some may also represent grains of dolomite that were not dissolved with the acid treatment.

No determinations were made on minerals of less than 2.87 sp. gr.

Of these lighter minerals, quartz and various feldspars are abundant. A very light amorphous mineral of about 2.0 to 2.3 sp. gr., commonly known as plant-opal, is present in the A_1 horizons of the Brunizem and Humic-Gley soils. No percentages were determined but the mineral was observed to be relatively abundant in the Humic-Gley soils. According to Beavers and Stephen (1958), the coarse, stiff-stemmed native vegetation (*Spartina, Andropogon, Carex,* etc.) is known to contain large quantities of this mineral.

Petrographical analyses of very fine sand.[1] The very fine sand fraction (0.05-0.10 mm.) from the heavy-mineral weight analyses were mounted in Canada balsam on microscope slides and petrographically analyzed for the relative frequencies of various heavy minerals (Appendix D, pages 152-153).

The kinds of heavy minerals were grouped into eight major classes: opaques, ferromagnesium, epidote-zoisite, garnet, tourmaline, zircon, accessories, and unknowns. No attempt was made to differentiate among the opaque minerals. Hornblendes and pyroxenes were combined into the ferromagnesium class because during the early part of the study the low iron hornblendes were not properly separated from diopside.

The data in Appendix D document a considerable amount of heavy-mineral information on the soils in this study. They do not show conclusive differences in heavy-mineral composition between horizons within a single profile or between comparable horizons developed in loess and till.

To more accurately document the heavy-mineral composition of these soils, a second, more detailed study was conducted on the very fine sand fraction with less pretreatment and without fixing the mineral grains on microscope slides. This procedure minimized alteration or destruction of the easily weatherable minerals (see Appendix B).

Selection of the soils and horizons included in this phase of the study was guided by two major objectives: (1) to contrast the heavy-mineral suite in calcareous tills of several textures with that in calcareous loess, and (2) to estimate the effect of the difference in weathering intensity between B and C horizons for soils in which both horizons were derived from loess or from till. Also of interest was the comparison of two contiguous soils developed in the same parent material but under different vegetative cover, i.e., Blount and Elliott.

Petrographic observations on the 0.05- to 0.10-mm. size fraction

[1] Data on the very fine sand fraction (Appendix D, pages 152-153, and Table 7) and most of the conclusions drawn are by R. B. Grossman, formerly Assistant in Agronomy.

(very fine sand) indicated that the suites in both the calcareous loess and the calcareous till were very similar, i.e., all minerals identified occurred in each material (Table 7). These observations showed that the amphibole group was composed mainly of green hornblende with lesser but significant amounts of pale green to colorless tremolitic varieties. Though commonly frayed, the grains did not appear particularly weathered. Opaque minerals were not differentiated but included magnetite and ilmentite, hematite-limonite group, and leucoxene. The pyroxene group consisted primarily of clinopyroxene. Part was pale green to colorless (diopsidic) and part was brownish (augite). The ends of the pale green to colorless grains had a "shingled" appearance, as if formed from overlapping plates. The brownish variety had distinctive crosshatched cleavage. An occasional hypersthene occurred. The epidote group included both epidote (mainly colorless to faint green with a few pea-green varieties) and lesser amounts of zoisite. Garnet ranged from colorless to faintly pink, with an occasional deep pink grain. Other minerals occurring in lesser amounts included apatite, zircon, tourmaline, collophane, chlorite, kyanite, sphene, rutile, sillimanite, anatase, and staurolite, listed in order of decreasing relative abundance.

It was noted that the pyroxenes in the loess were mainly diopsidic, whereas augite was the more common species in the till. Furthermore, it appeared that the augite species was more susceptible to degradation, as evidenced by the frequency of partial coating with opaque material and by ragged peripheries of the mineral grains.

The mineral assemblage and relative order of abundance is in fair agreement with the study by Lamar and Grim (1937) on the heavy minerals in a number of outwash and alluvial sand and gravel deposits found in Illinois. For two minerals, however, there is considerable variance; Lamar and Grim reported considerably more garnet and hypersthene than was found in this study.

Quantitatively, the very fine sand fraction of the loessial horizons tends to be more uniform in heavy minerals than does the till-derived horizons. In till, both the opaques and pyroxene groups are quite variable in occurrence. This greater uniformity among the loessial horizons is in accord with the observations by Haseman and Marshall (1945) from their study of loess in Missouri.

In general, the data in Table 7 show that calcareous loess contains a lower percentage of pyroxene and fewer opaques than calcareous till, but in turn is usually higher in epidote and amphibole. However, before inferring from mineralogical differences that a discontinuity exists between the parent loess and till materials of these soils, it is

Table 7.— Heavy-Mineral Distribution for the Very Fine Sand Fraction (0.1–0.05 mm.) From Selected Soil Horizons, Predominantly From Northeastern Illinois[a]

Soil series	Great Soil Group	Horizon and parent material	Lab. No.	Heavy minerals[b]															
				Opaque group	Amphibole group	Epidote group	Pyroxene group	Garnet	Apatite	Zircon	Tourmaline	Collophane	Chlorite	Sillimanite	Kyanite	Staurolite	Sphene	Rutile	Anatase
Blount..........	Gray-Brown Podzolic	B, till	17524	FA	A	VC	C	FC	FC	FC	S	S	..	..	R	..	S	..	..
		C, till	17527	FA	A	VC	C	FC	FC	FC	R	R	R	..	..	..	R	..	..
Ringwood........	Brunizem	B, till	17599	A	FA	FC	A	S	..	S	R	..	R	..	R	..	..	..	R
		C, till	17602	A	FA	FC	FA	R	S	S	R	R	R	..	..	..	..	..	..
Saybrook........	Brunizem	B, loess	17778	A	FA	VC	C	FC	R	S	R	R	R	..	..	R	..	..	..
		B, till	17779	FA	FA	VC	C	FC	R	S	R	R	R	R	R	..	R	..	..
		C, till	17780	A	VC	C	VC	C	S	S	R	R	R	..	..	R	..	R	..
Elliott..........	Brunizem	B, till	17508	VC	A	VC	C	FC	S	S	R	R	..	..	..	..	R	..	..
		C, till	17511	FA	FA	C	VC	FC	S	R	R	R	..	..	..	..	..	R	..
Clarence.........	Brunizem	B, till	17743	A	VC	FC	A	S	R	R	..	R	..	..	..	..	..	..	R
		C, till	17745	A	VC	FC	FA	S	R	S	..	FC	..	..	R	..	..	..	R
Tonica..........	Brunizem	B, loess	17801	FA	A	FA	FC	S	..	FC	R	..	R	..	R	..	R	R	..
		C, loess	17804	FA	A	VC	FC	FC	S	FC	R	R	R	..	S	..	R	..	R
		D, till	17805	A	FA	C	FA	FC	S	S	..	S	S	..	R	..	..	..	..
Muscatine.......	Brunizem	B, loess	17809	FA	FA	FA	R	FC	..	FC	R	..	S	R	S	..	R	R	..
		C, loess	17812	FA	A	FA	S	FC	S	FC	S	R	FC	R	S	R	R	..	..
		D, till	17814	A	VC	FC	VC	FC	S	S	R	R	R	..	..	..	R	..	..
Calcareous Peorian loess from Carroll county........	....	C, loess	.....	A	A	FA	VC	FC	S	FC	R	R	R	R	R	..	..	R	..

[a] Data in this table and most of the conclusions drawn are by R. B. Grossman, formerly Assistant in Agronomy.

[b] Symbols used to indicate relative amounts of the various heavy minerals are as follows: VA = very abundant (>60 percent), A = abundant (35-60 percent), FA = fairly abundant (20-35 percent), VC = very common (10-20 percent), C = common (5-10 percent), FC = fairly common (2-5 percent), S = scarce (1-2 percent), and R = rare (<1 percent). Percentages are based on numbers of grains counted. Two dots indicate minerals not observed though they may be present in very minor amounts.

necessary to consider the possibility that differences may be due to weathering. Loess always occurs as the surface material and has been subjected to more intense weathering. The key minerals, those in the pyroxene group, are more easily altered compared with epidote and even amphibole, according to Pettijohn (1941). And finally, evidence indicates a rather easily weatherable species of opaques is present in the calcareous till.

Although it may be assumed that the soil material is till-derived if a considerable percentage of pyroxene is present, particularly if high in augite, caution must be exercised because (1) it has not been determined whether till from all moraines in the area studied contains considerable pyroxene, (2) loess does contain some pyroxene, and (3) the effectiveness of a single size fraction to indicate the heavy mineralogy of a material is dependent on the richness of the deposit in that size fraction. This last point is particularly important to consider because sand constitutes a very minor proportion of loess. Furthermore, much or all of the sand found in thin deposits of loess, particularly if far removed from major loess sources such as that analyzed in this study, probably originated locally from the underlying till.

Under the weathering regime operative in this region, apatite and collophane are nearly completely removed from the very fine sand fraction in both loess-derived and till-derived B horizons. Opaques are higher in the calcareous till than associated B horizons. But the evidence from the comparisons of opaques in loess is conflicting; in one case there is an increase, while in the other, a decrease. This would suggest a relatively unstable mineral among the opaques but instability of the opaque group is not in accord with results reported by other investigators (Carroll, 1953, and Van der Marel, 1949). Also there is no consistent difference between the pyroxene content of the till-derived B horizons and the associated calcareous till C horizons. In three cases the pyroxene percentage in the B decreased from the C horizon and in two cases it increased.

The Brunizem (Elliott) and Gray-Brown Podzolic (Blount) soils developed in the same parent material were indistinguishable mineralogically in the very fine sand fraction, in respect both to the mineralogy of the B and C horizons taken individually and to the differences between the B and C horizons within each soil.

X-ray spectrographic analyses of coarse silt. The ZrO_2 content in the coarse silt fraction (20-50μ) of the till-derived soil samples indicated in Table 7 ranged from 0.028 to 0.036 percent in the C horizons

and from 0.054 to 0.076 percent in the B horizons. The ZrO_2 content in the coarse silt fraction of the same horizons of those soils indicated as having loessial origins ranged from 0.088 to 0.115 percent. These data indicate that in the coarse silt fraction the ZrO_2 content is higher in loess than in till of Wisconsin age. However, for the very fine sand fraction (0.05-0.10 mm.) the ZrO_2 content in all of the soil horizons studied is relatively constant and ranges between 0.014 and 0.028 percent. There is no consistent difference in ZrO_2 content between the loess and till horizons for the very fine sand fraction.

A qualitative analysis was made for Sr, Rb, Cu, Zn, Fe, Mn, and Ti in the coarse silt fraction of the horizons listed in Table 7. With the exception of Mn, the content of each of these elements is higher in the loessial horizons than in the till horizons.

Thus X-ray spectrographic analyses indicate that differences in composition do occur in the coarse silt fraction (20-50μ) between loess and tills of Wisconsin age, but that little or no difference occurs in the very fine sand fraction (0.05-0.10 mm.). This latter observation agrees in general with the heavy-mineral petrographical analyses of the very fine sand fraction, although small differences are reported in Table 7 and the accompanying discussion.

Further mineralogical characterization of loess and till of Wisconsin glacial age by X-ray spectrographic analysis of the silt fraction is in progress and will be reported at a later date.

CHARACTERISTICS OF GRAY-BROWN PODZOLIC AND ASSOCIATED GRAY-BROWN PODZOLIC INTERGRADE TO BRUNIZEM SOILS

The name "Gray-Brown Podzolic" as applied to a group of soils was first used by Baldwin in 1928. He described the morphology of the solum in considerable detail, presented data on chemical composition, and used the Miami series as an example to represent the group. Marbut (1936) designated these soils as a Great Soil Group and differentiated them from the Podzol soils. The 1938 Yearbook of Agriculture, "Soils and Men," defines Gray-Brown Podzolic soils as "a zonal group of soils having a comparatively thin organic covering and organic-mineral layers over a grayish-brown leached layer which rests upon an illuvial brown horizon; developed under deciduous forest in a temperate moist climate." This rather sketchy and broad definition fits the present concept of this soil group. Both Baldwin and Marbut

indicated that the parent materials of these soils are variable. This is also true in northeastern Illinois (see page 29).

The above definition restricts the typical Gray-Brown Podzolic soil to one with an "illuvial brown horizon," i.e., a well-oxidized B horizon. All imperfectly and poorly oxidized soils developed under forest vegetation in northeastern Illinois therefore should probably be excluded from this group or be considered as transitional to some other Great Soil Group. Of the profiles studied, Fox, McHenry, and Miami are well oxidized and are classed as true Gray-Brown Podzolic soils. Blount and Eylar are imperfectly oxidized but will be discussed with this group. Beecher and Frankfort, two imperfectly oxidized soils classified as Gray-Brown Podzolic intergrade to Brunizem, are also included in the discussion of this group.

Eleven Gray-Brown Podzolic profiles representing 5 soil series, and 3 Gray-Brown Podzolic intergrade to Brunizem profiles representing 2 soil series were studied. The series names and profile numbers are given in Table 1. Detailed field descriptions are given in Appendix A and detailed analytical data are given in Appendix C for each profile studied. Horizon color and thickness differences of two members (McHenry and Eylar) compared with the corresponding Brunizem and Humic-Gley soils are shown in the colored plate facing page 61.

Occurrence

Gray-Brown Podzolic soils occupy a minor portion of the landscape of the area included in this study in northeastern Illinois. The larger areas of these soils are indicated on the colored map (in pocket inside back cover) by the letter B following numbers 1 through 10. They are also indicated on the general vegetation map (Fig. 16, page 70) as areas of forest vegetation. As shown on these maps, Gray-Brown Podzolic soils are most extensive in the extreme northern counties. They occupy approximately 25 to 50 percent of the upland areas in Lake, McHenry, Boone, Kane, and Du Page counties. In these counties the native forest vegetation originally covered many gently sloping areas in addition to steeper valley slopes. In the remaining counties, Gray-Brown Podzolic soils are found primarily on the steeply sloping land adjacent to the major streams, and occupy from 10 percent to as little as 1 percent of the land area.

In Tazewell, Woodford, and Peoria counties the Gray-Brown Podzolic soils are derived primarily from loess. On the tabular divides in these counties the loess cover on the glacial till averages more than 5 feet thick; on steep slopes the loess cover is usually thinner.

Native vegetation

Many species of hardwoods were present in these soil areas, with mixed oak and hickory being dominant. Less important species were soft and hard maple, elm, black walnut, ash, and basswood. These latter were often the first to encroach on the grasslands, being replaced later by the oak-hickory climax. Much of the original forest, except on the steeper slopes, was cleared shortly after settlers entered Illinois. A high percentage of the originally forested areas, therefore, has been under cultivation for more than a century.

In recent field mapping several soils have been recognized which are considered intergrades between Gray-Brown Podzolic and Brunizem soils, possessing properties intermediate between the two. These forest-prairie transition soils apparently occur in areas that have been only lightly forested or forested for a relatively short time. They often occur as narrow bands between true Gray-Brown Podzolic and Brunizem soils, although more extensive areas may occasionally be found. A few of the larger areas are shown on the colored map (in pocket inside back cover) by the letter C following the numbers 4, 5, and 8. They are also shown on the general vegetation map (Fig. 16, page 70) as mixed forest-prairie vegetation areas. These transition soils have the same kind and sequence of horizons as the Gray-Brown Podzolic soils, but have a thicker A_1 horizon if virgin, or a darker A_p horizon if cultivated.

Morphology

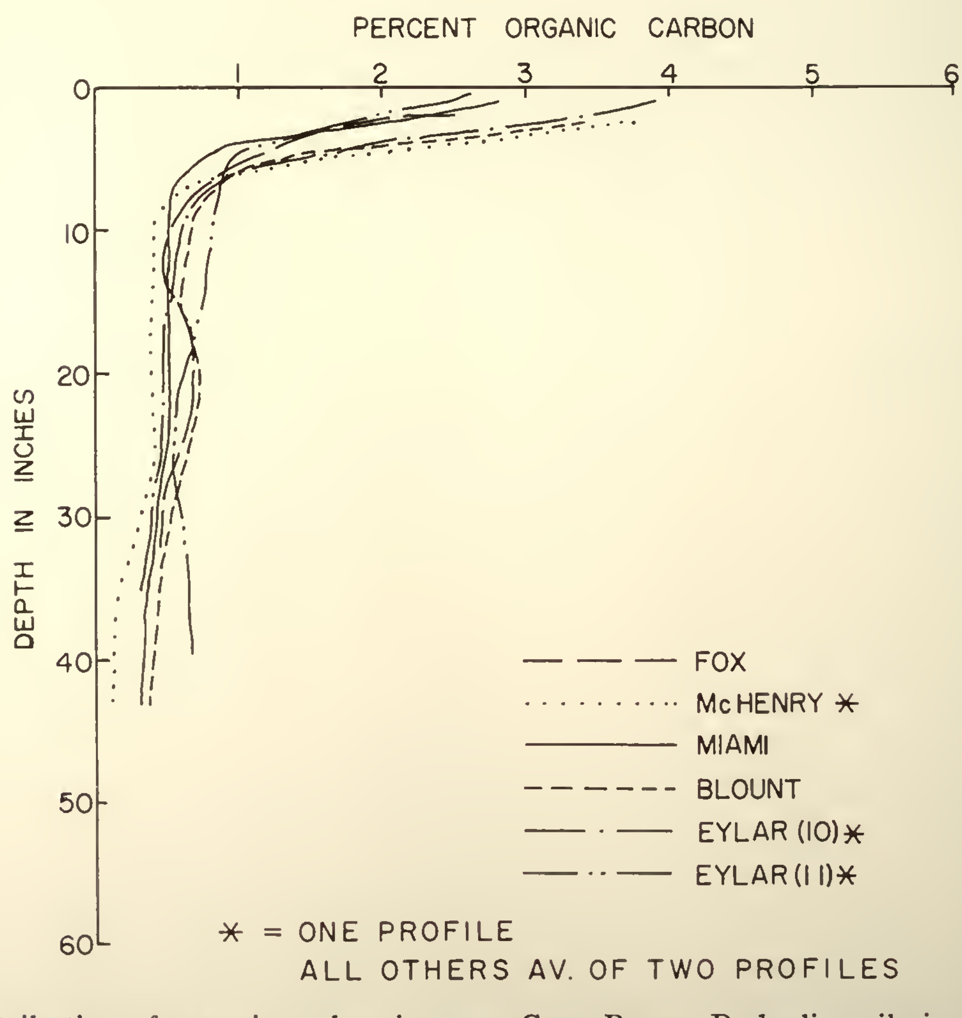
The Gray-Brown Podzolic soils have unique profile characteristics which contrast sharply with the Brunizem and Humic-Gley soils. Under oak-hickory vegetation a very thin, dark A_1 horizon forms. This is the zone of organic accumulation. This horizon will range in thickness from about 2 to 5 inches in virgin areas (see colored plate facing page 61). The color of the A_1 horizons of the soils studied varies from black (10YR 2/1) to very dark brown (10YR 2/2) to dark gray (10YR 4/1). The dominant texture is silt loam and the structure is primarily crumb or soft granular.

The A_2 horizon occurs immediately below the A_1 horizon and is normally considered a zone of maximum removal or eluviation in the profile. Iron and aluminum have moved out, resulting in an increase in silica. Organic carbon is relatively low (Fig. 10). This horizon, averaging 3 to 9 inches thick in the soils studied, varies in color from brown (7.5YR 5/4) or yellowish-brown (10YR 5/4) to dark grayish-brown (10YR 4/2) or grayish-brown (10YR 5/2) to pale brown

(10YR 6/3). The yellow and brown colors are associated with the more strongly oxidized or better-drained soils with coarser-textured parent materials; the grayish-brown and pale-brown colors are more generally associated with those soils having finer-textured parent materials and more restricted drainage. Undisturbed A_2 horizons frequently have a thin platy structure which varies in degree of development. Crumb or weak granular structure is sometimes present. The dominant texture is silt loam.

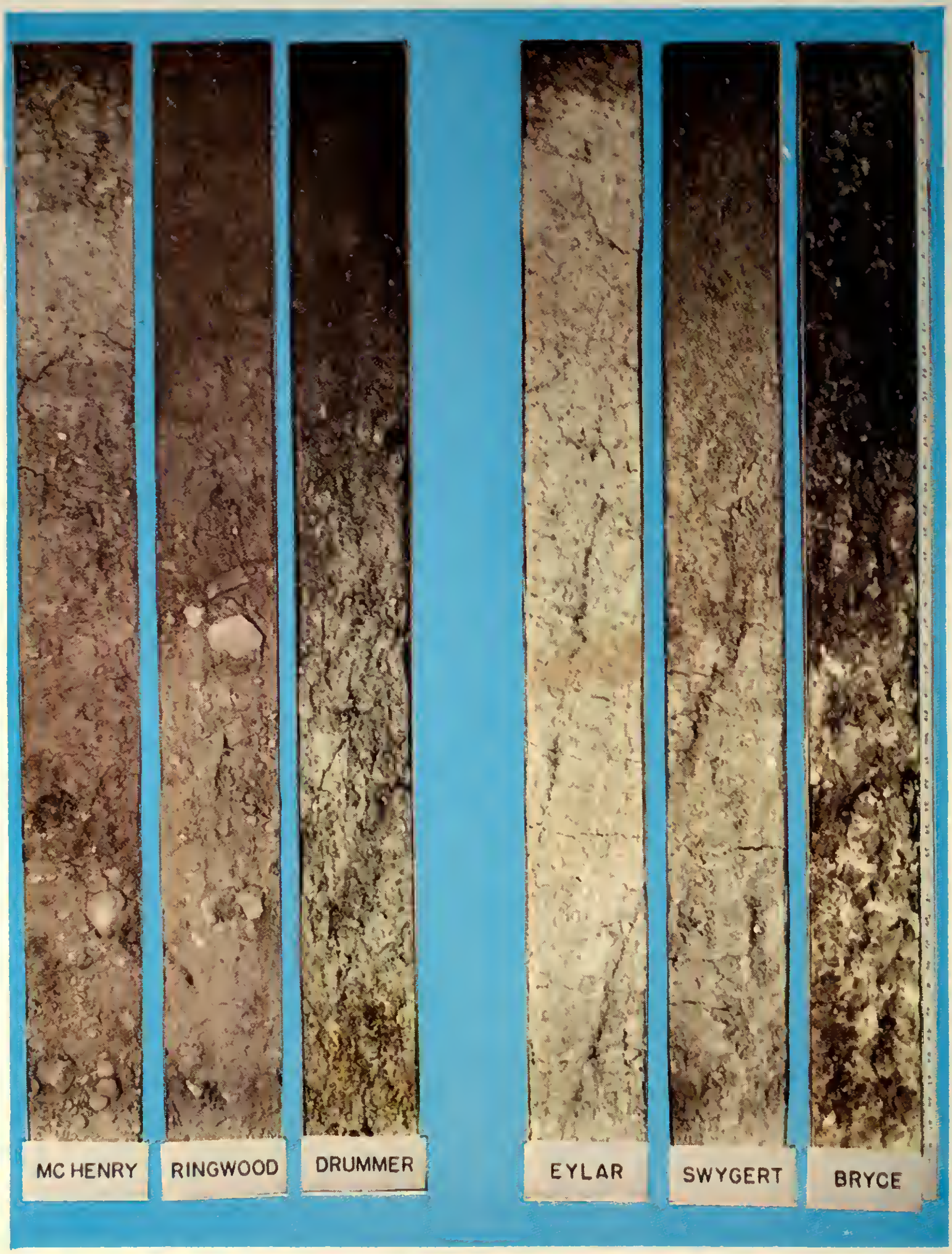
In cultivated areas of Gray-Brown Podzolic soils, the A_1 and A_2 horizons are mixed, resulting in an A_p horizon which is thicker, but lighter in color, than the original A_1 horizon. Cultivation produces a thinner A_2 horizon, if any remains, than the original A_2 horizon.

In a few profiles a thin A_3 horizon is present which has properties intermediate between A and B horizons. This horizon is a minor one in the Gray-Brown Podzolic soils studied.



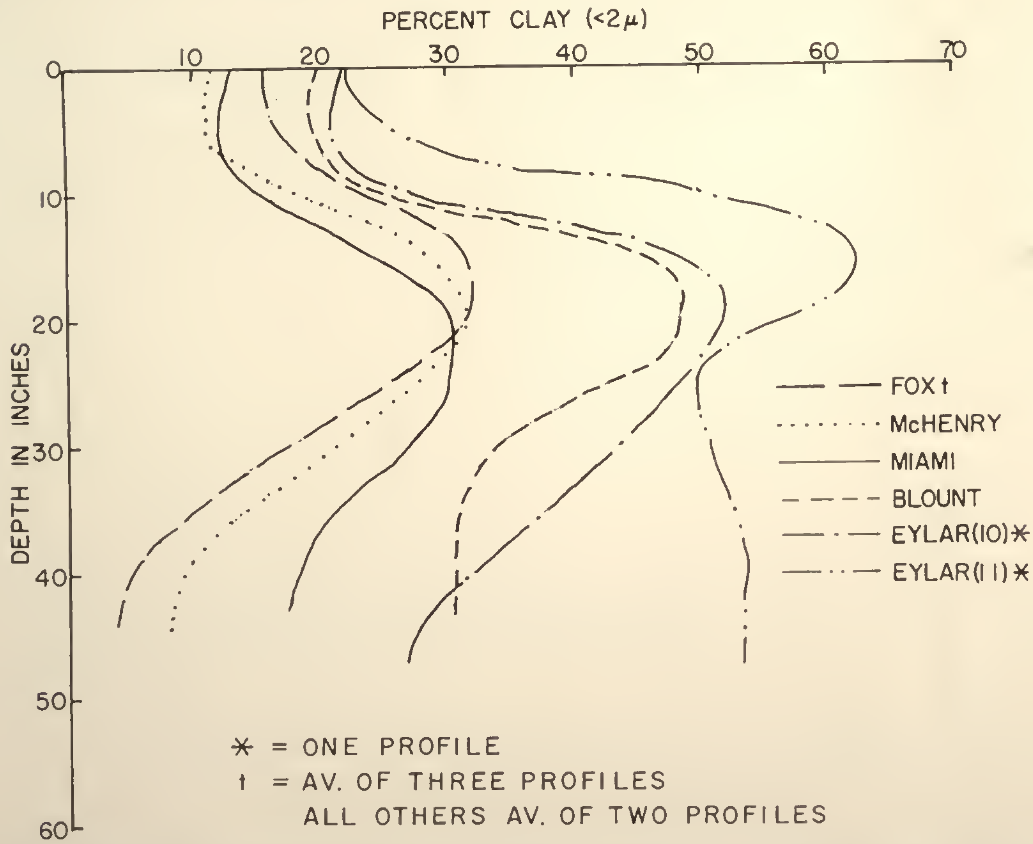
Distribution of organic carbon in some Gray-Brown Podzolic soils in northeastern Illinois. (Fig. 10)

COLOR PHOTOGRAPH OF PROFILES OF SIX SOIL SERIES FROM NORTHEASTERN ILLINOIS



Profiles of six soil series from northeastern Illinois to a depth of 50 inches. McHenry and Eylar are light-colored soils developed under deciduous forest. Ringwood and Swygert are dark-colored soils developed under tall-grass prairie. McHenry and Ringwood are derived from thin loess on calcareous sandy loam till. Eylar and Swygert are derived from thin loess on calcareous silty clay till. Drummer is the very dark-colored, moderately fine-textured, poorly oxidized, outwash-derived Humic-Gley associate of Ringwood. Bryce is the very dark-colored, finer-textured, poorly oxidized Humic-Gley associate of Swygert.

The B horizon is an illuvial horizon with a clay content greater than the A or C horizons in all profiles (Fig. 11). This horizon is characterized, in addition to the higher clay content, as ranging from approximately 1 to 2 feet thick and having a rather well-developed fine to medium subangular blocky structure in the most strongly developed portion. In the well-oxidized profiles, color of the B horizon is primarily brown (7.5YR 5/4 or 10YR 4/3-5/3), yellowish-brown (10YR 5/4), or reddish-brown (5YR 4/4) to dark reddish-brown (5YR 3/4). Reddish brown colors predominate in the distinctive B_3 or Beta horizon (Bartelli and Odell, 1960) which occurs in the lowest part of the sola of Fox and McHenry and sometimes in Miami soils. In those soils with finer-textured parent material (silty clay loam or finer) the B horizons are finer textured (Fig. 11) and the structure usually is more blocky. The type and class of structure is frequently medium to coarse subangular blocky to angular blocky with an occasional tendency toward prismatic. Thin clay films occur on many of the sand grains, iron-manganese concretions, and aggregate faces in the middle B and as channel and cavity coatings in the lower B horizon.

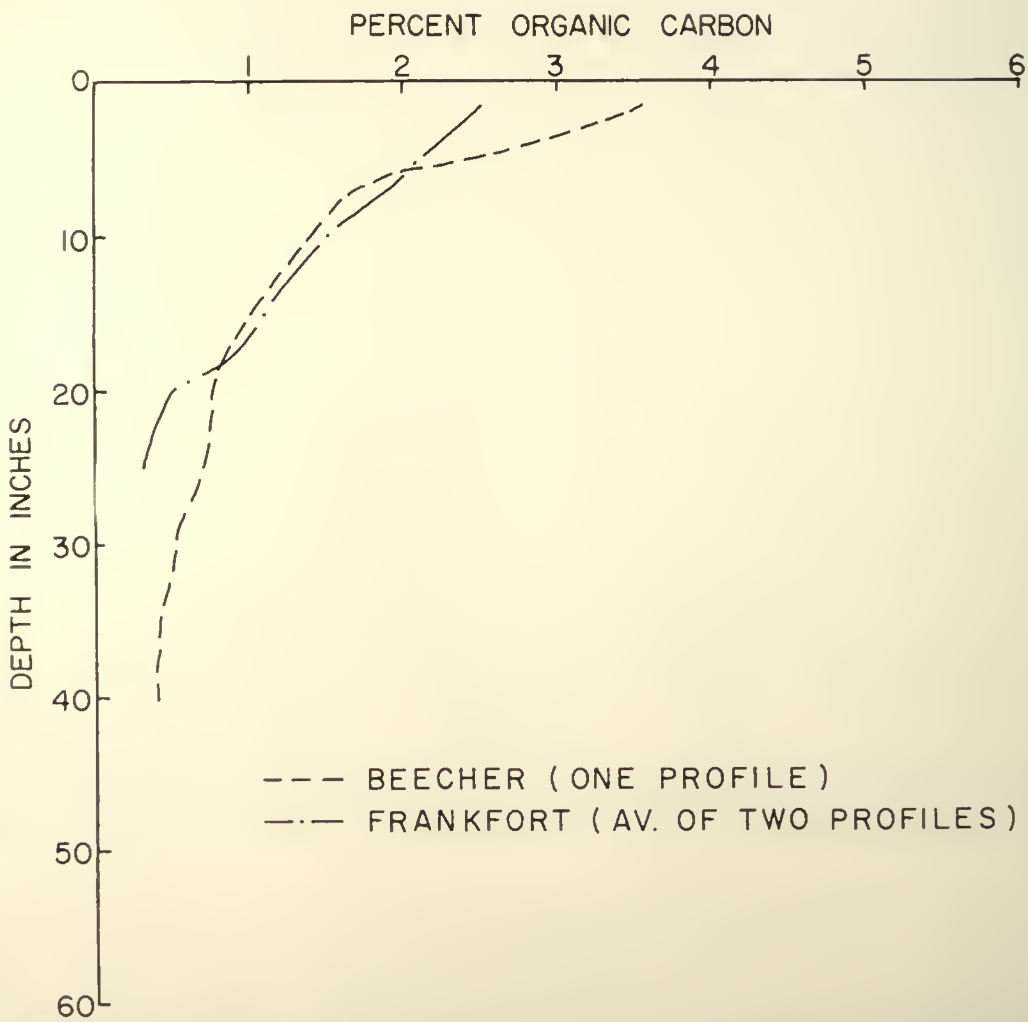


Distribution of clay (<2μ) in some Gray-Brown Podzolic soils in northeastern Illinois. Data are based on <2-mm. material. (Fig. 11)

Soils formed from the finer-textured materials frequently show the effect of restricted drainage. They are more gray and mottled in the B horizon than the better-drained soils derived from coarser-textured materials.

The thickness of the sola ranges from 18 inches in Eylar (No. 11) to 39 inches in Miami (No. 7). The thinner sola are associated with the finer-textured parent material when comparisons are made on the same slope gradient. The C horizons cover a great range in color and texture as discussed in the section on parent material (page 29).

The forest-prairie transition soils, as illustrated by Beecher (Nos. 12 and 13) and Frankfort (No. 14), differ from the true Gray-Brown Podzolic soils in having a thicker A_1 or a darker A_p horizon. The trend in organic-carbon accumulation in the profile shows a more gradual decrease with depth (Fig. 12). The higher average content



Distribution of organic carbon in two Gray-Brown Podzolic intergrade to Brunizem soils in northeastern Illinois. (Fig. 12)

in the B horizon is probably related to the dark coatings of organic matter on the structural surfaces of this horizon. This morphological characteristic is often helpful in identifying some transition soils in field mapping.

A study by Alexander (1951) indicated that the transition soil Beecher may have accumulated more clay in the B horizon than the associated Gray-Brown Podzolic (Blount) or Brunizem (Elliott) soils. Such a relationship existed at one of the sampling sites. Too few profiles of other parent materials have been studied to verify such a morphological difference between the prairie-forest transition soils and the associated Gray-Brown Podzolic and Brunizem soils.

Physical properties

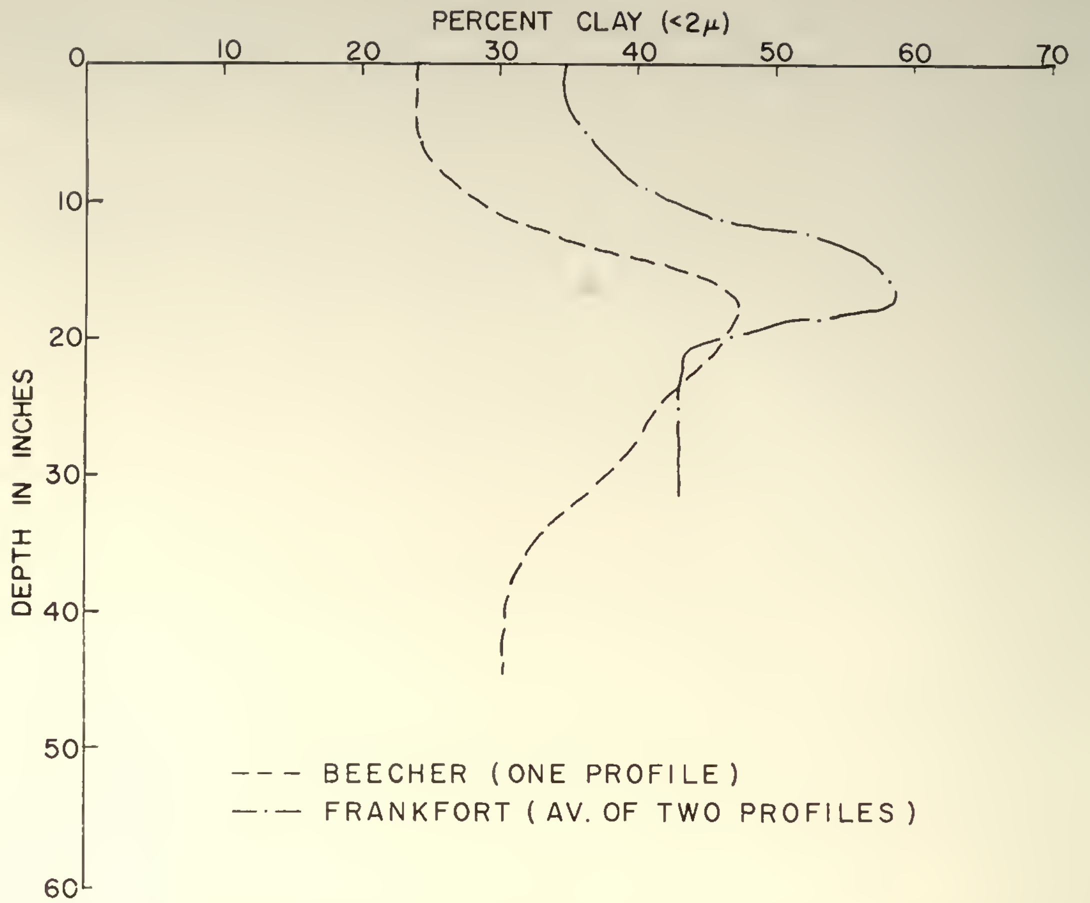
Difference in particle-size distribution is probably the most important single soil characteristic among the Gray-Brown Podzolic and intergrade profiles studied. It accounts for many of the individual profile differences. It is also the most important single, observable property which can be employed in delineating areas of these various series in field mapping.

As discussed previously, the parent glacial till material is classified into six textural groups. These same textural differences are not readily apparent in the A_1 horizons of these soils because they have been influenced sufficiently either by loess or by soil developmental processes so that their textures are similar. Ten profiles of the 14 considered here have a silt loam texture in the A_1 horizon. Two Fox (Nos. 2 and 3) soils have loam A_1 horizons and Beecher (No. 13) and Frankfort (No. 14) have silty clay loam A_1 horizons.

Many of the A_2 horizons show a decrease in clay and sand content and an increase in silt content when compared with the A_1 horizons.

The B horizons show a wide textural range among the Gray-Brown Podzolic profiles studied. They vary from a sandy clay loam in portions of two Fox profiles (Nos. 2 and 3) to clay in one Eylar profile (No. 11). The B horizon textures of Miami and McHenry soils are clay loams or silty clay loams whereas those of the Blount and Eylar soils including the prairie-forest transitions, Beecher and Frankfort (Fig. 13), are all silty clays or clays.

The B horizons vary in maximum clay percentage from 24.8 in one Fox (No. 2) to 63.0 in one Eylar (No. 11). In the Blount and Eylar soils, clay content in the B horizon is related directly to that in the parent till, whereas in the Fox, McHenry, and Miami soils there is not



Distribution of clay ($<2\mu$) in two Gray-Brown Podzolic intergrade to Brunizem soils in northeastern Illinois. Data are based on $<$2-mm. material. (Fig. 13)

as close a relationship. Sand and gravel are not important in the B and C horizons of Blount and Eylar. They are progressively more important in the Miami, McHenry, and Fox soils, respectively, particularly in the C horizon (unleached till).

Extreme differences in texture characterize the C horizons. Of special significance is the high gravel and sand content in the Fox and McHenry soils and the high clay content in the Frankfort and Eylar soils. These differences have been fully discussed in the section on parent materials (page 29). The parent material of the Eylar series may be either silty clay or clay texture. The Eylar (No. 10) profile, sampled to represent that portion of the series with silty clay parent material, has solum characteristics that are representative of Eylar, but the texture of the lower C horizon is not as fine as normally found in the range of the series.

Available moisture-holding capacity was determined as the differ-

ence between water held at ⅓-atmosphere and 15-atmosphere tension. The validity of this moisture relationship depends to a great extent on how accurately the moisture percentage of 15-atmosphere tension represents the moisture content at the wilting point on samples of high clay content. Data were not obtained on all profiles studied, but from that shown in Appendix C the trend is as follows: Eylar > Blount > Miami > McHenry > Fox. In these soils, available moisture (⅓-atmosphere tension minus 15-atmosphere tension) ranges from 7.0 inches in Fox to 12.2 inches in Eylar, calculated to a depth of 5 feet. The kind of crop grown and the depth of rooting in individual soils greatly modifies the amount of water available to a given crop. Information on depth of corn root penetration in Brunizem soils is presented on page 79. This information is believed applicable to the Gray-Brown Podzolic soils where parent till materials are similar to the Brunizems studied.

Bulk-density determinations show similar trends for most of the profiles with the lowest values occurring in the surface horizon and the highest values in the unweathered parent material. The A_1 horizons range from 1.03 to 1.60 and the calcareous horizons from 1.56 to 1.88 in this property.

Variations in hydraulic conductivity are not great among the Gray-Brown Podzolic profiles if the soils are rated on the basis of the horizon with the lowest conductivity. According to the data, all profiles would rate moderately slow or slower (Hockensmith, 1948) except one Fox (No. 2), which is rapid. The values are lower for the Fox (Nos. 1 and 3), McHenry, and Miami soils than expected and lower than field experience indicates. In general the trend in hydraulic conductivity should be as follows: Fox > McHenry > Miami > Blount > Eylar.

Chemical properties

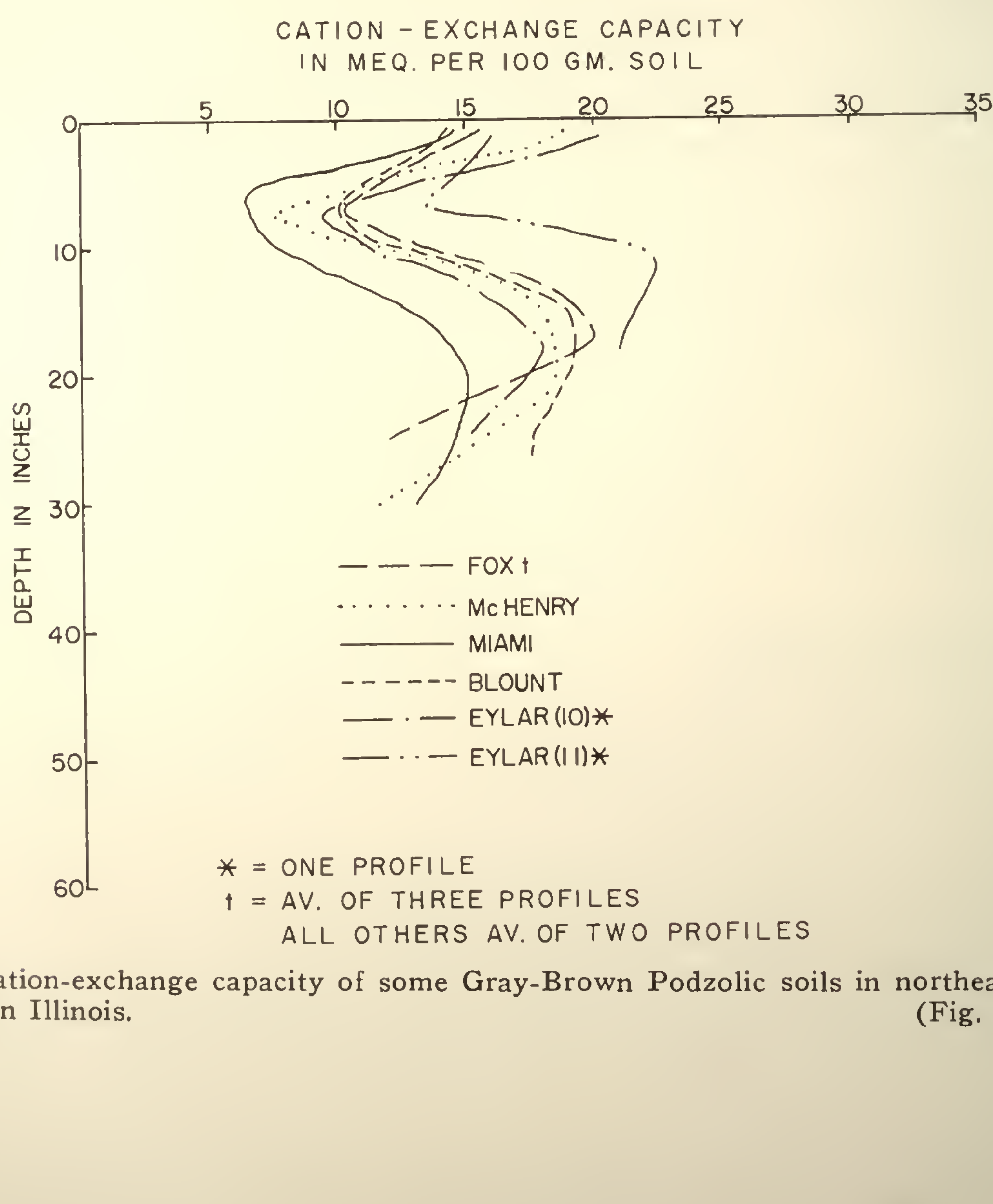
The organic carbon in the Gray-Brown Podzolic and prairie-forest transition soils is concentrated primarily in the thin A_1 horizon (Figs. 10 and 12). The range in this horizon is from 2.0 percent in Blount (No. 9) to 4.4 percent in Fox (No. 3), or approximately 3.5 to 7.5 percent organic matter. Some of these soils equal or exceed the organic content of the Brunizem soils in this horizon, but because the horizon is very thin in the Gray-Brown Podzolic soils, the organic content of the total A horizon is much less than in the Brunizem soils.

Organic carbon decreases sharply to less than 1 percent in most of the A_2 horizons of the Gray-Brown Podzolic soils. The higher values

of the transition soils (Beecher and Frankfort) in the A_2 and B horizons is significant and aids in characterizing them.

The pH values of the surface horizons are extremely variable, probably owing to the effect on certain profiles of either lime dust from gravel roads or field liming. The lowest pH values usually occur in the upper B horizons with sharp increases from the lower B to the C horizons. The pH values for one Fox profile (No. 2) are uniformly high throughout the profile, which is not typical for the series.

The phosphorus tests, P_1 (adsorbed) and P_2 (adsorbed plus acid soluble, Bray, 1942b), show wide variation among the soils. The P_1 test indicates low adsorbed-phosphorus levels in many horizons of most of the soils. It also shows low values for the calcareous parent materials. The P_2 test indicates increases from the A to the B horizons, but in the C horizons some profiles are low and others are high. The

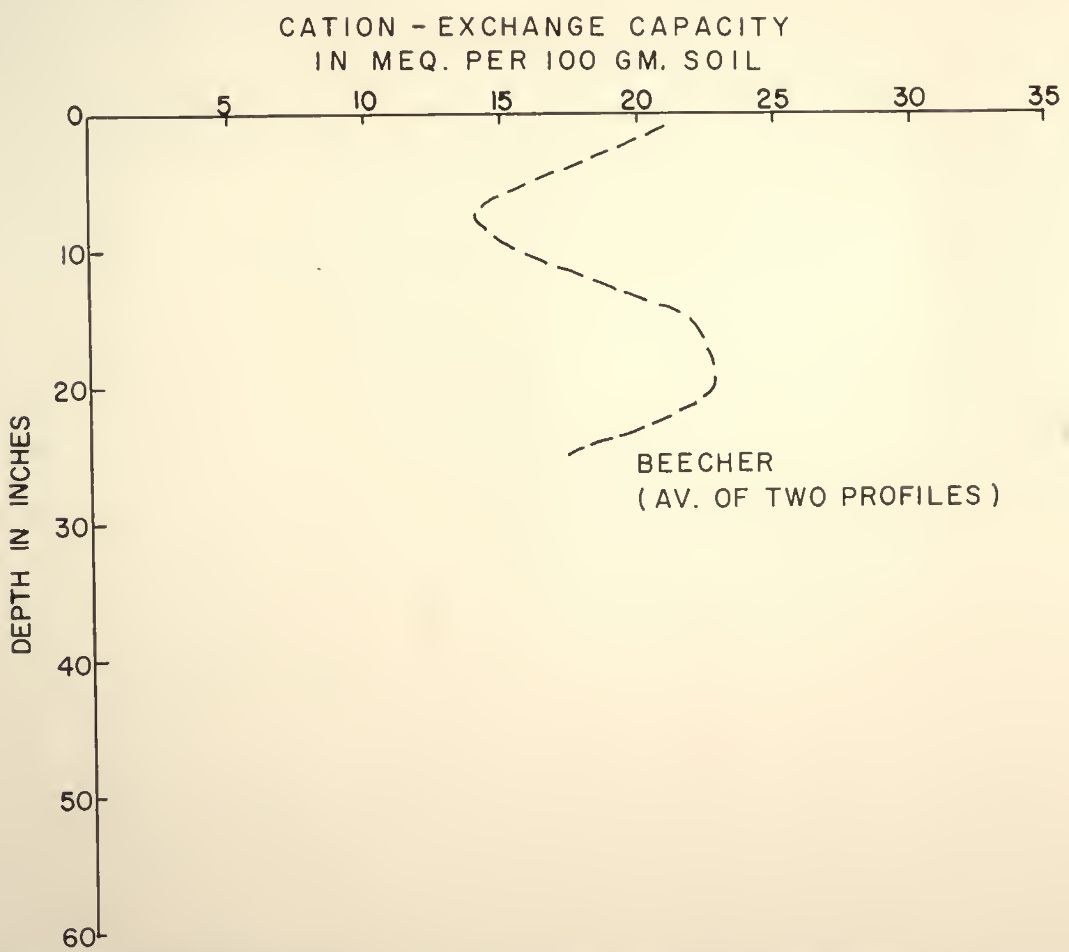


Cation-exchange capacity of some Gray-Brown Podzolic soils in northeastern Illinois. (Fig. 14)

McHenry (Nos. 4 and 5) soils have the highest values for both tests in the surface horizons of any of the Gray-Brown Podzolic soils studied.

Cation-exchange capacity curves have the same trends for all profiles studied, including the forest-prairie transition soils (Figs. 14 and 15). The A_1 horizon is one of the high points on each curve because of the organic-matter content. Cation-exchange capacities range from 10 to 21 meq. per 100 gm. in this horizon for all 14 soils analyzed. The A_2 and/or A_3 horizons at depths of 4 to 10 inches are low points in each profile. These horizons have the lowest combined values of organic and inorganic colloids. The lowest value, 5 meq. per 100 gm. of soil, occurs in the A_2 of one Miami profile (No. 7).

A second high point in the cation-exchange capacity curves occurs in the middle of the B horizon, which coincides with the zone of maximum clay accumulation. The exchange capacities in this horizon



Cation-exchange capacity in a Gray-Brown Podzolic intergrade to Brunizem soil in northeastern Illinois. (Fig. 15)

usually equal and frequently exceed the values in the A_1 horizons. The highest value is 28.4 meq. per 100 gm. in Beecher (No. 12).

With increasing depth into the lower B horizons, the cation-exchange capacities again decrease. The lowest value is 4 meq. per 100 gm. in the B_{31} of Fox (No. 2). In this horizon the combined amounts of silt and clay total less than 10 percent of the <2-mm. fraction.

When the cation-exchange capacities in the B horizons are attributed to the clay fraction only, some interesting relationships are indicated (Appendix C). Fox and McHenry soils have high average values and are close together at approximately 60 to 61 meq. per 100 gm. of clay. Miami and Blount are somewhat lower with an average of about 51 meq. and 43 meq. per 100 gm., respectively, and Eylar is lowest with an average of approximately 36 meq. per 100 gm. of clay. Although the values vary between individual profiles of the same series, the averages are directly related to the content of montmorillonite in the B horizons of these soils (see Table 6).

Total base status of the profiles shows a range in the surface horizon of 8.4 meq. per 100 gm. in one Blount (No. 9) to 22.5 meq. per 100 gm. in one McHenry (No. 4). The Miami profiles have the lowest values of this group of soils. One Fox (No. 1) has a high total base content throughout its solum.

Percent base saturation of these soils varies from relatively high in the surface to low in the A_2, A_3, and upper B horizons, and back to high in the lower B horizons. Two Fox profiles (Nos. 1 and 2) are highly saturated, which is not typical of the series as described in other areas. The No. 3 Fox profile is more typical in its saturation status. The Miami soils (Nos. 6 and 7) are much lower than the other soils with values of 39 and 32 percent, respectively, in the lower portion of the A_2 horizons. These low saturation values for the Miami soils, combined with the narrow Ca/Mg ratios in the A_2 horizons, suggest that they may be more highly weathered than the soils developed from both finer- and coarser-textured parent materials.

Exchangeable calcium represents the largest proportion of the combined bases, followed in order by magnesium, potassium, and sodium. These soils appear to be well supplied with calcium in the surface horizons. The Miami profiles are lowest in calcium. Two Fox profiles (Nos. 1 and 2) have a high calcium content that is maintained through all horizons. Available potassium levels are quite high in these profiles; however, some of the A_2 and upper B horizons have levels lower than recommended for maximum crop production.

Use

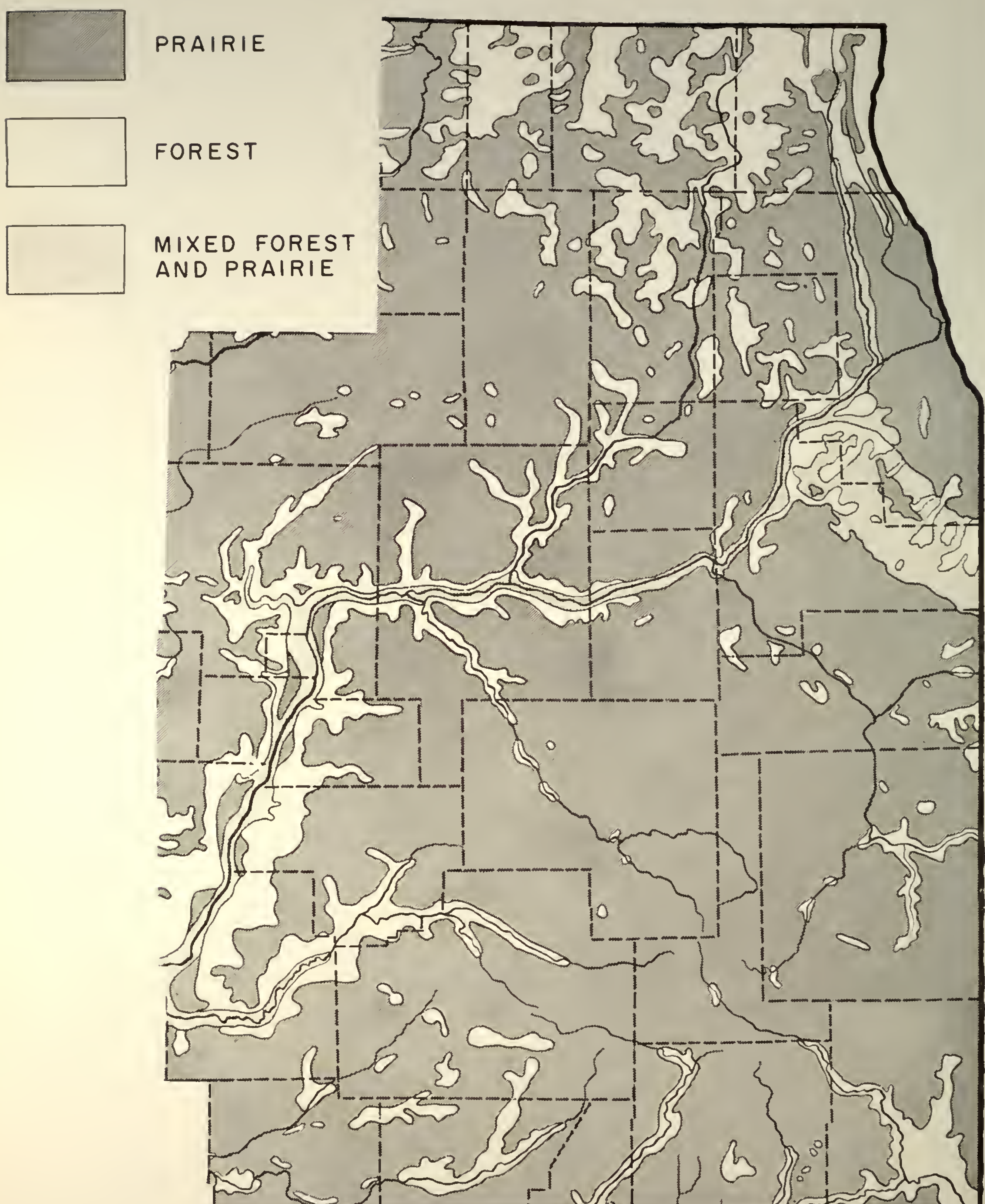
The Gray-Brown Podzolic and Gray-Brown Podzolic intergrade to Brunizem soils, formed in glacial till or thin loess over glacial till in northeastern Illinois, have a lower natural fertility level than the Brunizem and Humic-Gley soils of the same region. However, when properly fertilized and managed they become highly productive except those with physical handicaps, such as Eylar and Frankfort soils, which have a high clay content in their B and C horizons.

As a group, these soils are deficient in organic matter and nitrogen. Efficient use of manures and crop residues is recommended and the use of nitrogen fertilizer is usually a profitable practice. Like the majority of glacial-till soils, they have a good supply of available potassium but available phosphorus levels are generally low and phosphate fertilization normally gives good results.

Treatment experiments on Miami silt loam at the Antioch soil experiment field in Lake county (Bauer *et al.,* 1951; field now discontinued) show yield increases due to phosphate fertilizers on corn, oats, wheat, and hay. Additions of limestone and potash had little effect on yields. In general the Gray-Brown Podzolic soils in northeastern Illinois require more lime than the Brunizem and Humic-Gley soils. In some areas the lime requirement is low as indicated by the Antioch soil experiment field data.

As mentioned previously a high percentage of the Gray-Brown Podzolic soils in northeastern Illinois occur on steeply sloping topography, and in some instances they have never been cleared for cultivation. Steeply sloping areas that have been cleared of trees and brush should be either replanted to trees or provided with other permanent vegetative cover. Erosion control is a major problem on these soils. The surface (A_1 horizon) containing the bulk of organic matter is thin and quickly removed by runoff water. Intertilled crops should be restricted mainly to nearly level or gently sloping areas with suitable erosion-control measures used on slopes greater than about 2- or 3-percent gradient.

The soils with well-oxidized sola, i.e., Fox, McHenry, and Miami, are naturally well drained and require no artificial drainage. The other soils discussed with this group are more poorly drained owing largely to the higher clay content in the B and C horizons. Tile drainage will normally benefit the level and gently sloping areas of Blount and Beecher soils, but the use of tile drainage is considered impractical and uneconomical in the Frankfort and Eylar soils because of their high clay content and resultant very slow permeability.



Distribution of soils exhibiting the genetic effects of native forest and native prairie vegetation in northeastern Illinois. The major areas of mixed prairie-forest and/or transition prairie to forest are also shown. (Fig. 16)

CHARACTERISTICS OF BRUNIZEM SOILS

The Brunizem soils (see Simonson, Riecken, and Smith, 1952), formerly called "Prairie" soils, are dark colored, naturally well drained or well oxidized, and occur primarily on undulating to rolling topography. A rather complete characterization of these soils is given by Smith, Allaway, and Riecken (1950). In the 1938 Yearbook of Agriculture, "Soils and Men," the Brunizem soils are described as follows:

"The typical Brunizem[1] soils have developed in cool, moderately humid climates under the influence of grass vegetation. These soils occur in the Middle West and occupy a large part of the Corn Belt. The profiles are characterized by dark brown to nearly black, mildly acid surface soils underlain by brown, well-oxidized subsoils. The parent materials have a wide range in composition, especially in their content of lime. The Brunizem soils differ from those of the Chernozem group in having a slightly lighter color of the surface soil and in the absence of a zone of lime accumulated by soil-forming processes."

The foregoing definition restricts typical Brunizem soils to those with "brown, well-oxidized subsoils." It excludes imperfectly and poorly oxidized soils that otherwise are very similar. Thus, of the soils developed under prairie vegetation in northeastern Illinois sampled for this study only Warsaw, Ringwood, and Saybrook should be classed as Brunizems. Elliott, Swygert, and Clarence show some evidence of gleying and may be considered as intergrades between Brunizem and Humic-Gley. The differences in the degree of oxidation or natural drainage are due neither to slope nor to depth to the permanent water table but to the influence of texture of the material from which the soils were formed on permeability and aeration. For the purposes of this study all dark-colored, well-, moderately well-, and imperfectly-oxidized soils are included as Brunizems.

Detailed field descriptions of the Brunizem soils for which samples were collected for this study are given in Appendix A. Detailed analytical data are given in Appendix C. Horizon color and thickness differences of two members (Ringwood and Swygert) compared with Gray-Brown Podzolic and Humic-Gley soils are shown in the colored plate facing page 61.

Occurrence

Brunizem soils occupy 25 to 50 percent or more of the area of most of the counties in northeastern Illinois. They occur primarily on the

[1] The authors have substituted *Brunizem* for *Prairie* in this quotation.

broad, gently rolling till plains usually at some distance from the major stream valleys. Combined with Humic-Gley, areas of these soils are indicated on the colored map (in pocket inside back cover) by the letter A following numbers 1 through 10 and on the general vegetation map (Fig. 16, page 70) as areas of native prairie vegetation.

The humid, temperate climate of northeastern Illinois is sometimes called the "Oak-Hickory Climate" owing to the strong regional coincidence with that hardwood forest association. Although the present climate seems to support grasses and trees equally well, observations indicate that forest vegetation was encroaching on the prairie areas until halted by cultivation.

Norton and Smith (1931) suggested that restricted drainage was primarily responsible for the presence of Brunizem soils in Illinois and that forests had not invaded the main prairie areas because of the high water table and poor drainage that existed. However, Brunizem soils as defined by Simonson, Riecken, and Smith (1952) and as considered here did not have a water table high enough to prevent the establishment of most of the tree and shrub species growing in the adjacent forests. Also some species require poor drainage and a high water table and these could have invaded all wet areas, including Humic-Gleys, if given enough time.

The presence of Brunizem soils over a large portion of northeastern Illinois and the persistence of prairie vegetation in undisturbed areas may be the result or aftereffect of the warm-dry (semiarid) period from 4050 to 2050 B.C. (Flint, 1947). If forests were invading the prairies as suggested above, encroachment was undoubtedly slow, because tree seedlings find establishment difficult in a dense grass sod as well as being easily killed by prairie fires. Also encroachment may have been halted several times or possibly reversed by arid conditions for short periods during the last 4,000 years.

Native vegetation

The prairies of Illinois at the time of earliest settlement consisted mainly of five species of grasses: big bluestem (*Andropogon furcatus*), Indian grass (*Sorghastrum nutans*), slough grass (*Spartina pectinata*), little bluestem (*Andropogon scoparius*), and switch grass (*Panicum virgatum*). Big and little bluestem and Indian grass were found on the better-drained sites, with slough grass and some switch grass in areas with a water table near the surface. The bluegrasses (*Poa*), although present in large areas at the present time, are not indigenous to the United States but were introduced by the early settlers.

Morphology

The Brunizem soils in northeastern Illinois have A_1 horizons varying in color from very dark gray (10YR 3/1) to black (10YR 2/1) to very dark brown (10YR 2/2) and ranging in thickness from 5 to 14 inches with an average of about 10 inches in the profiles studied. The predominant structure is crumb to soft granular, and consistence is friable.

Most Brunizems have an A_3 (transition A-B) horizon that averages about 3 to 4 inches thick where present. It varies in color from very dark grayish-brown (10YR 3/2) to dark grayish-brown (10YR 4/2). The structure is usually fine to medium granular but occasionally grades to very fine to fine subangular blocky in the lower part of the horizon.

The B_1 horizons are generally brown (10YR 4/3) to dark grayish-brown (10YR 4/2) in color and average about 4 inches thick. The structure is normally weak fine subangular blocky.

From the A_1 through the B_1 horizons most of the soils considered as Brunizems in this study are similar. However, in the B_2 horizon and below, the effect of texture of the underlying glacial till is apparent. Normally as the texture of the till becomes finer and thereby restricts air and water movement, the B_2 horizon exhibits progressively poorer oxidation or drainage characteristics.

In the better-drained Brunizem soils (Warsaw, Ringwood, and Saybrook) the thickness of the B_2 horizon averages about 10 inches. The color varies from dark brown (7.5YR 4/3) to brown (10YR 5/3) to strong brown (7.5YR 5/5). The structure is generally fine to medium, weak to moderate subangular blocky.

In the Elliott, Swygert, and Clarence profiles the B_2 horizon also averages about 10 inches thick but the color is more gray and mottled. The predominant colors are gray (10YR 5/1), light brownish-gray (10YR 6/2), olive-brown (2.5Y 4/4), and light olive-brown (2.5Y 5/4), with mottles of yellowish-brown (10YR 5/4) to pale brown (10YR 6/3). The structure of these B_2 horizons is primarily fine to medium, moderate to strong angular blocky.

The B_3 is a transitional horizon between the B_2 and the C horizon. In the profiles studied it averages about 6 inches thick where present. It is usually absent in those soils derived from fine-textured till. Where present in the latter soils it is very thin. In soils developed in the coarser-textured materials, the color ranges from dark brown (7.5YR 4/4) to brown (7.5YR 5/4) and it has been designated as a Beta horizon by Bartelli and Odell (1960). In soils developed in the finer-

textured materials, the B_3 horizon ranges from yellowish-brown (10YR 5/4-5/6) mottled with brownish-yellow (10YR 6/6) to light olive-brown (2.5Y 5/4). The structure varies from weak to moderate, medium subangular blocky.

The C (calcareous till) horizons vary widely in texture and color as discussed previously under the section on parent materials.

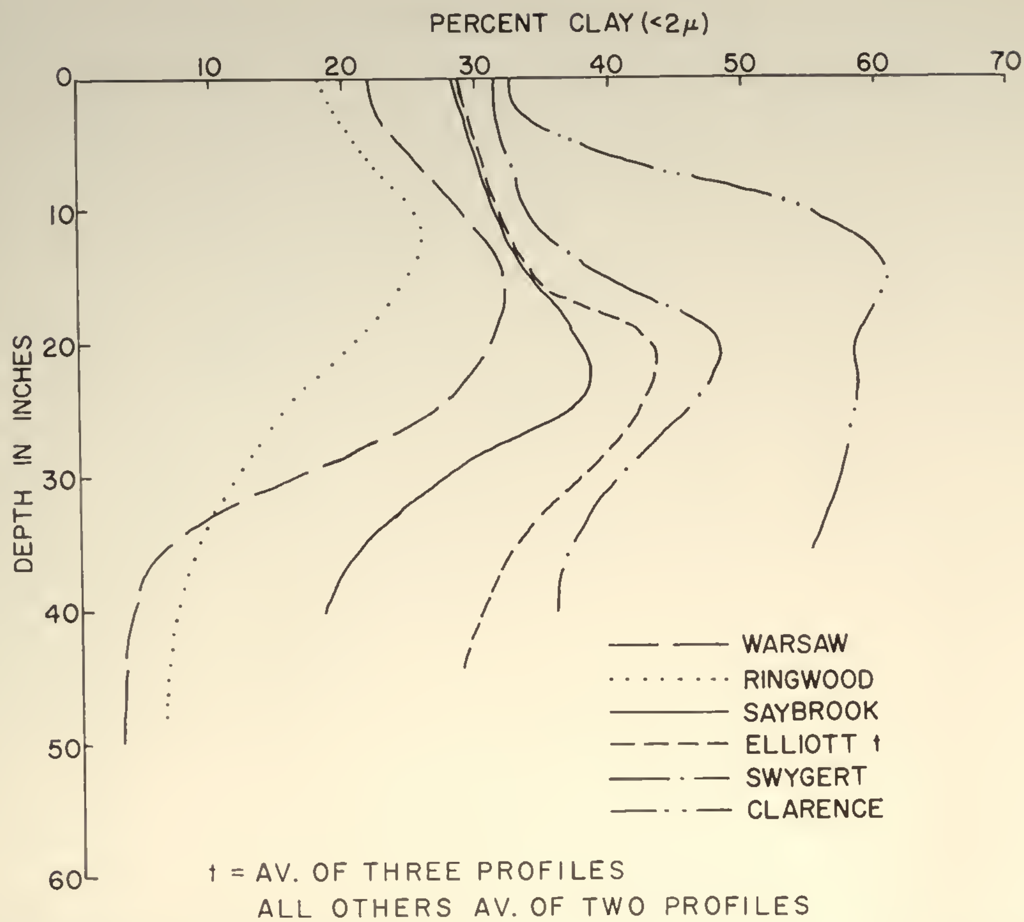
The average depth of solum or depth of leaching of calcium carbonate is greatest in Ringwood and least in Clarence (see discussion of parent material, page 38). Warsaw, which is developed on loamy gravel till, is not leached as deeply as Ringwood, developed on sandy loam till (Table 4). This may be due partly to a thicker covering of loess or other medium-textured material on the gravel in Warsaw and partly to the size of the limestone rocks present in the till. As till texture grades from sandy loam to clay the sola average progressively thinner. This indicates that as the clay content of the parent material increases, permeability decreases and less water percolates through the profile, resulting in a shallower depth of leaching and thinner solum. The average depth of solum in the Brunizem soils studied ranges from about 26 inches in Clarence to 37 inches in Ringwood.

Physical properties

The clay ($< 2\mu$) percentages of the A_1 horizons of the Brunizem soils analyzed in this study vary between a minimum of 18.0 percent in one Ringwood (No. 17) and a maximum of 35.4 percent in one Clarence (No. 27). This is a range of 17.4 percent, which is considerably smaller than the range in either the B_2 (49.1 percent) or the C (65.7 percent) horizons. It indicates that the A horizons have developed in a material more uniform (probably loess) than the till materials beneath.

The maximum percentages of clay in these soils occur in the B_2 horizons, except the two Ringwoods (Nos. 17 and 18). The highest clay percentage in both Ringwood profiles was found in the horizon identified as B_1. Several other profiles also show the percent clay in the B_1 closely approaching or equaling that of the B_2 horizon.

The average clay maximum is highest in Clarence and lowest in Ringwood (Fig. 17). However, the accumulation of clay or increase in the B compared with the underlying, unleached, associated till averages least in Clarence and Swygert, intermediate in Elliott, and greatest in Saybrook, Ringwood, and Warsaw. This indicates that weathering was slowest in the fine-textured till soils and most rapid in the medium to coarse textures.



Distribution of clay (<2μ) in some Brunizem soils in northeastern Illinois. Data are based on <2-mm. material. (Fig. 17)

Average depth to the clay maximum in the Brunizem soils studied increases as till texture becomes coarser, from Clarence through Swygert and Elliott, respectively, to Saybrook (Fig. 17). This further indicates that weathering is slowest in the finest-textured material (clay) and is progressively more rapid through silty clay, silty clay loam, and loam to silt loam textures, respectively. However, the trend does not continue through sandy loam and loamy gravel.

Bulk densities in the surfaces range between 0.98 and 1.29, while in the parent material they range between 1.55 and 1.76. This is the general trend in all nine of the Brunizem profiles for which data were obtained. The lowest bulk density recorded was 0.98 in the surface of a Warsaw (No. 15) and the highest was 1.76 in the parent materials of a Ringwood (No. 17) and a Saybrook (No. 19) at a depth of about 40 inches.

The forces of weathering tend to develop soil aggregates and, up to a certain point, increase pore space. Also the soil flora and fauna add organic matter which has a lower density than mineral matter.

These changes result in lower bulk densities in the upper solum as compared with the lower solum and unweathered parent material. In general, the tills high in clay have relatively lower bulk densities than those low in clay. This difference may be due to differences in sand, silt, and clay content and amount of water held; however, differential packing and compression by the glaciers is also a possibility.

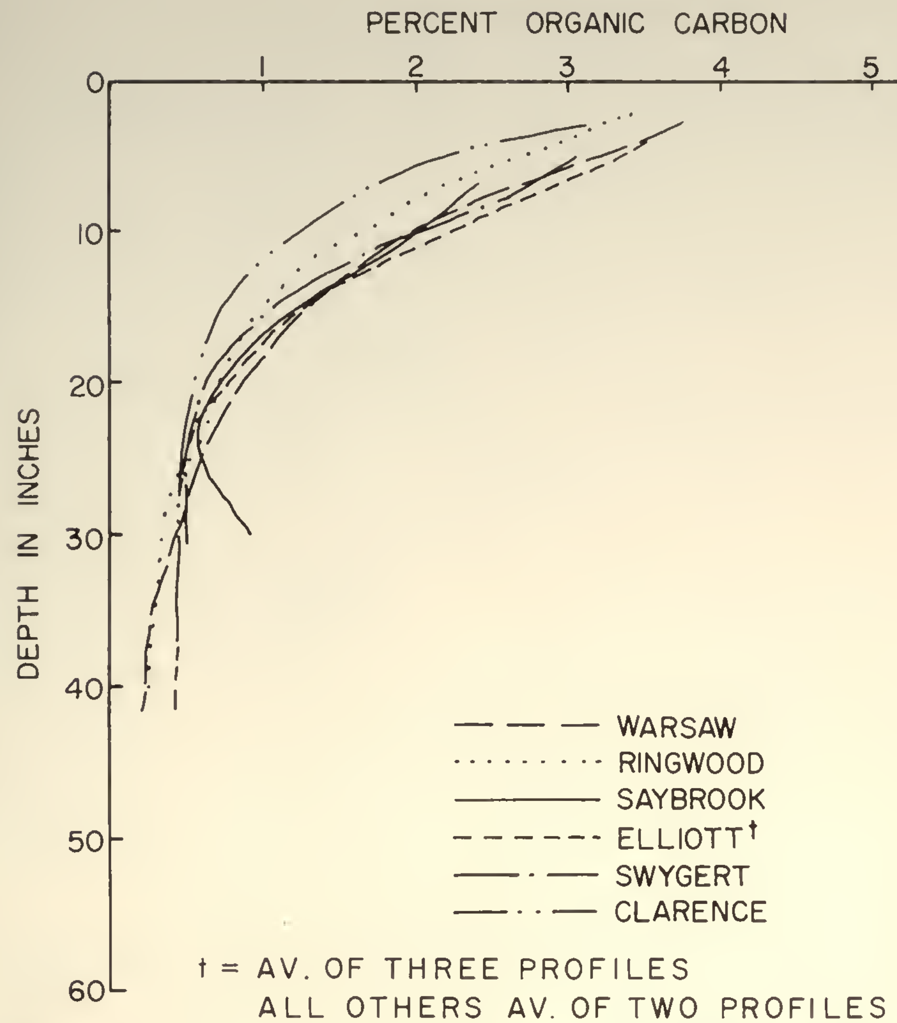
Available moisture is assumed to be that amount of water that a soil can hold between ⅓-atmosphere and 15-atmosphere tension. This portion of soil moisture is considered available to growing plants. The capacity of soils to hold this moisture increases as clay content increases up to approximately silty clay loam texture and then tends to remain relatively constant, as pointed out by Odell (1956). In the Brunizem soils studied, Ringwood and Warsaw have the lowest field capacity (total water held at ⅓ atmosphere) and Clarence the highest to a depth of 5 feet. However, plants do not root as deeply in Clarence as in other Brunizem soils and are therefore limited to a smaller supply of available moisture in this soil as compared with the coarser-textured, more permeable soils.

Chemical properties

The Brunizem soils tend to be intermediate in organic-carbon and organic-matter content between the Humic-Gley and Gray-Brown Podzolic soils. The organic carbon in the surfaces ranges from 2 to 5 percent. This is a range of 3.5 to 8.5 percent of organic matter. The organic-carbon content decreases gradually with depth to less than 1 percent at a depth of 25 inches (Fig. 18). This is similar to the Humic-Gley soils but differs from the Gray-Brown Podzolics. With increasing clay content in the underlying till, organic carbon tends to accumulate to a shallower depth. This also corresponds to the thickness of solum as discussed previously.

No clear pH relationship or trend was found among the various Brunizem soils studied. However, within most profiles the pH in the upper surface is between 5.8 and 7.7 and decreases to its lowest values in the lower A or upper B horizon. It then increases to a common value of 7.9 to 8.3 in the calcareous parent material. Some of these profiles were collected along or near graveled roads where road dust high in calcium and magnesium carbonates may have raised the pH level in the surface, although virgin profiles of Brunizem soils exhibit the same trend.

The cation-exchange capacity of the Brunizem soils is related to the amount of organic matter and the kind and amount of clay miner-

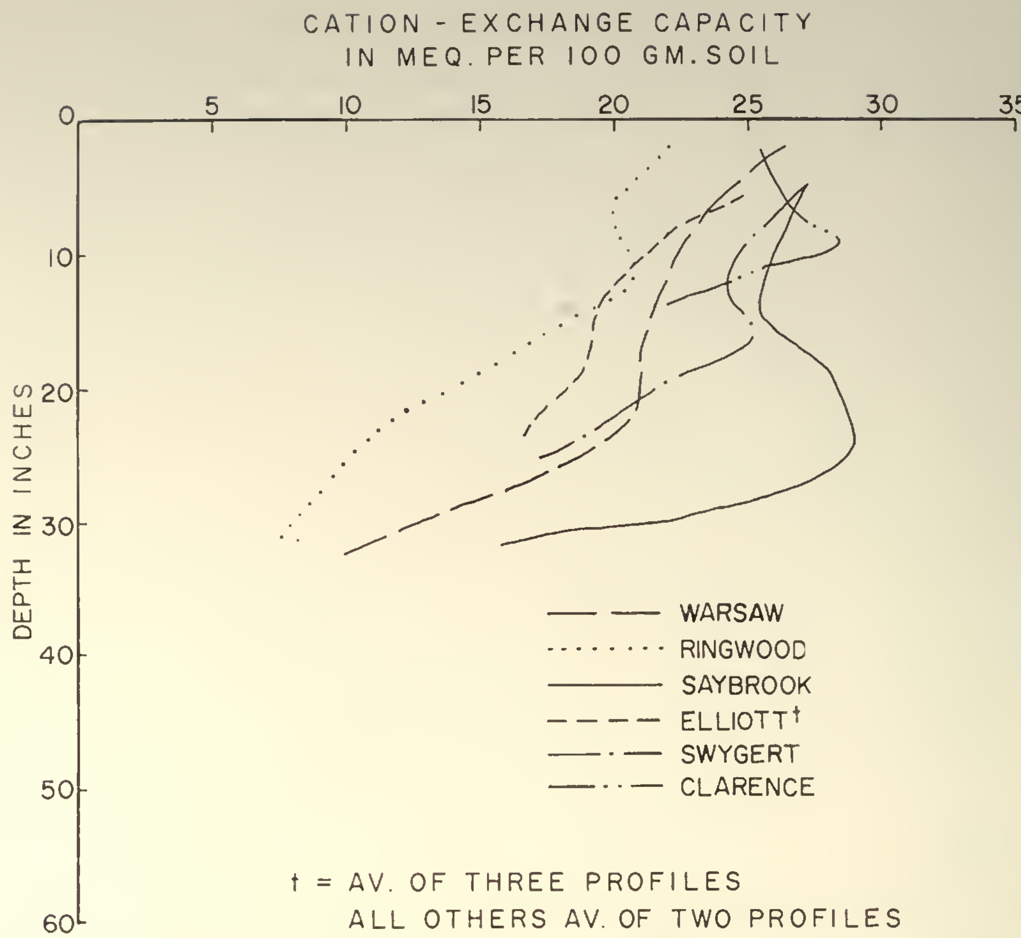


Distribution of organic carbon in some Brunizem soils in northeastern Illinois. (Fig. 18)

als in the soil (Fig. 19). The A_1 horizons have a high cation-exchange capacity because of higher amounts of organic matter, whereas the B_2 horizons have relatively high capacities largely because of higher clay content (Fig. 17).

No consistent relationship exists between cation-exchange capacity and texture of the underlying parent material. The amount of total bases in these soils shows no explainable relationship to either depth or texture of parent material.

Calcium is the most abundant exchangeable cation, with lesser amounts of magnesium, potassium, and sodium, respectively. No consistent relationship in the amount of exchangeable calcium is noted among the Brunizem soils. However, within individual profiles the A_3 and B horizons tend to be lower than the A_1. In the profiles studied the range of exchangeable calcium in the A_1 is 11 to 18 meq. per 100



Cation-exchange capacity of some Brunizem soils in northeastern Illinois. (Fig. 19)

gm. of soil and in the B horizon, 4 to 15 meq. Exchangeable magnesium shows no consistent relationship to either depth or soil type.

The ratios of exchangeable calcium to exchangeable magnesium in the Brunizem soils all tend to follow a similar pattern, i.e., widest in the upper A horizon to narrowest in the middle or lower B horizon. Narrow ratios in the B horizons indicate a moderate degree of weathering.

Exchangeable potassium is highest in the surface and decreases with depth. Surface contents range from 0.25 to 1.23 meq. per 100 gm. of soil. There is a slight tendency for the amount of exchangeable potassium to be greatest in the lower sola of the soils developed in the finer-textured tills.

Exchangeable sodium is low in all profiles and the variation with depth is small. There is a slight tendency for the lower horizons in the soils developed in the finer-textured tills to be highest in exchangeable sodium.

Use

The Brunizem soils in northeastern Illinois are considered fertile, i.e., moderately high to high in plant nutrients, except possibly phosphorus. However, because of marked differences in physical composition these soils vary widely in susceptibility to erosion, need for artificial drainage, tileability, and other management practices. Studies by Odell (1947, 1948a) indicate that the productivity of these soils is also influenced by their physical composition.

Results of corn root studies on four Brunizem soils in northeastern Illinois were reported by Fehrenbacher and Rust in 1956. These studies showed that corn roots penetrated to a maximum of about 4½ feet in Ringwood and Saybrook soils but to only slightly below 3 feet in Elliott and Clarence soils. The authors concluded that "the differences in depth of root penetration and in available soil moisture in the rooting zones are probably the main factors responsible for differences in long-time average corn yields on these soils" (see table on page 24).

Some studies on the effect of thickness of topsoil on corn yields were reported by Odell and by Rust. On Swygert silt loam Odell (1948b) found the following corn yield decline per inch of decrease in thickness of surface soil:

	Yield decrease per inch of decrease in thickness of A horizon	
Year	*A horizon 2-7 inches thick (bushels per acre)*	*A horizon 7-16 inches thick (bushels per acre)*
1946	5.0	3.1
1947	4.2	2.2

On Elliott silt loam, Rust (1950) found the following decline in corn yields per inch of decrease in thickness of surface soil:

Year	*Yield decrease per inch of decrease in thickness of surface soil*
1949	1.3 bushels per acre
1950	1.1 bushels per acre

From these data it is apparent that an inch of remaining topsoil on Swygert silt loam is more important in determining total yield of corn than an inch of topsoil on Elliott silt loam. It is also apparent that a significant reduction in corn yields occurs following loss of a few inches of A horizon from both soils.

Smith (1950) showed that crops grown on the Elliott-Ashkum soils on the Joliet experiment field in northeastern Illinois responded more to the application of rock phosphate than did the same crops grown on the Muscatine-Sable soils developed in deep loess on the Kewanee

experiment field in northwestern Illinois. He suggested that the permeability of the profile to roots, probably influencing the character of root growth, may be a major factor influencing crop response to rock phosphate.

CHARACTERISTICS OF HUMIC-GLEY SOILS

Humic-Gley (Humic-Glei) soils are defined (see Thorp and Smith, 1949) as a "group of poorly to very poorly drained hydromorphic soils with dark-colored organic-mineral horizons of moderate thickness underlain by mineral glei horizons." In addition Thorp and Smith indicated that these soils "occur naturally under either swamp-forest or herbaceous marsh vegetation mostly in humid and subhumid climates of greatly varying thermal efficiency" and "range from medium acid to mildly alkaline in reaction."

Until artificially drained, Humic-Gley soil areas had a permanent water table at or near the surface. Moisture conditions were such that oxidation of the mineral compounds remained at a near minimum. Growth conditions for certain plants were favorable and slough grasses (*Spartina*), various sedges (*Carex*), and other wet-prairie or marsh vegetation produced large accumulations of organic matter. The water table was not above the mineral soil surface long enough for peat to accumulate nor did it seasonally recede to such depths that oxidation of organic matter was accelerated or leaching of bases along with other soil weathering and developmental processes materially hastened.

Detailed field descriptions of the important Humic-Gley soils associated with glacial till in northeastern Illinois are given in Appendix A. Horizon color and thickness differences of two members (Drummer and Bryce) compared with the corresponding Gray-Brown Podzolic and Brunizem soils are shown in the colored plate facing page 61. Detailed analytical data are given in Appendix C. The horizon designations used in the tables are those of the field descriptions. They do not always correspond to horizon distinctions indicated from a study of the laboratory data. This is also pointed out by Schafer and Holowaychuk (1958). In analyzing several profiles of Humic-Gley soils of Ohio they concluded that on the basis of clay accumulation the upper B horizon lay within the dark topsoil layer.

Occurrence

Humic-Gley soils are an important feature of the landscape in northeastern Illinois. They occur on broad flats of usually less than 1-percent slope, in small depressions or along upland drainageways.

They have developed partly or wholly in all of the various textures of till as well as in associated outwash and loessial materials. They occupy more than 50 percent of the area of two counties (Livingston and Iroquois) in this region and more than 25 percent of the area of several more. The extent of combined Brunizem and Humic-Gley soils is shown on the vegetation map (Fig. 16, page 70), and on the colored map (in pocket inside back cover) by the letter A following the numbers 1 through 10.

Morphology

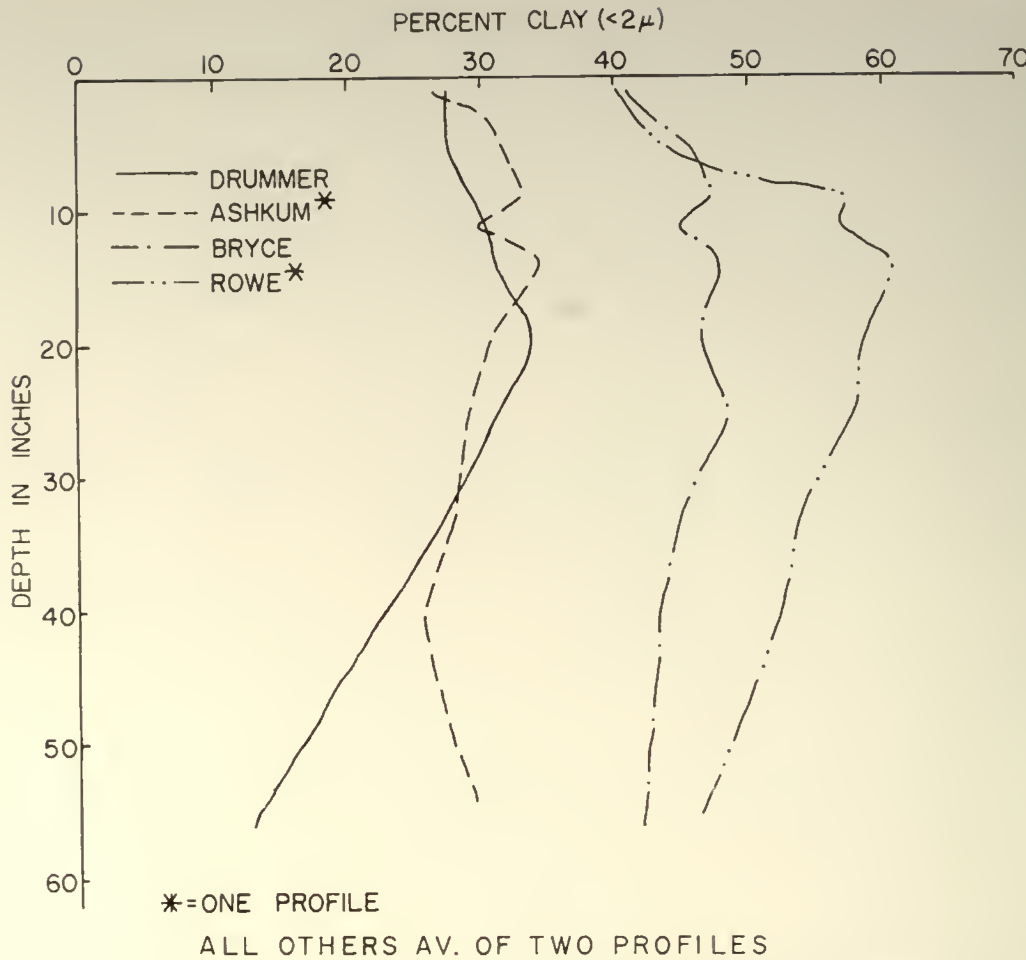
The generalized morphology of a Humic-Gley soil profile of the till region of northeastern Illinois has approximately the following color, thickness, and texture: The surface or A horizon is black (10YR 1/1-2/1). It varies from about 8 inches to 15 inches in thickness and from loam to silty clay in texture. The thinnest A horizons tend to occur in those profiles having B and C horizons of highest clay content.

The subsoil or B horizon is primarily dark gray (2.5Y 4/1) to dark grayish-brown (10YR 4/2) with mottles of olive-brown (2.5Y 4/4) to yellowish-brown (10YR 5/6). It averages about 18 or 20 inches thick but ranges from 11 to 30 inches in the profiles studied. Texture ranges for the most part from silty clay loam to silty clay but in weakly developed, medium-textured profiles it may be only loam or silt loam. Beneath the B horizon the C material may be of variable composition but the parent tills are separable into texture groups as discussed in the section on parent material (page 29).

Physical properties

In the six Humic-Gley profiles studied some portion of the described B horizon has a somewhat higher percentage of clay than any part of the A or C horizon in the same profile (Fig. 20). The difference is small, however, and the maximum in the B exceeds the average of the A horizon by more than 5 percent in only three of the six profiles. Also the differences between the A and B horizons are not consistent in relation to the kind of associated till. This tends to indicate parent material other than the associated till.

The $<2\mu$ clay content is greater than 60 percent in part of the B horizon of Rowe and less than 36 percent in all horizons of the Drummer and Ashkum. These great differences are less likely due to variable degrees of weathering in these soils than to origin of parent material. Local wash from adjacent till slopes would tend to carry a content of clay proportionate to that contained in the till. These local



Distribution of clay ($<2\mu$) in some Humic-Gley soils in northeastern Illinois. Data are based on $<$2-mm. material. (Fig. 20)

slope-wash materials, mixed with some incoming loess, offer a logical explanation of the extremely different clay contents.

Part of the clay in the sola is in the coarse fraction (between 2.0μ and 0.2μ) but most of it is in the fine fraction ($<0.2\mu$). The greater concentration of total clay in the B horizon than in the A horizon apparently is due to an accumulation of the fine fraction. This is true in all profiles except Ashkum which appears to have had more fine clay accumulate in the A than in the B horizon. Whether this will apply to all Ashkum soils is doubtful. This accumulation of fine clay in the B horizon is an indication of fine-clay formation through weathering and its transportation from the A into the B and deposition as coatings on the aggregates or as linings of old root channels and pore spaces.

The lower clay content in the 10- to 12-inch sampling layer of Ashkum, Bryce, and Rowe may be of importance (Fig. 20). The same

trends are not present in the fine clay fraction of these same profiles but are present in the coarse clay fraction. This change in particle-size distribution at this depth, particularly the coarse clay fraction, indicates a change in orginal parent material rather than differential weathering.

Sand is of little importance in the sola of these soils or in the C horizon of Ashkum, Bryce, and Rowe. It is of significance in the material beneath the B horizon in the two Drummer profiles.

Total silt content varies inversely with clay content in the B horizons of the Humic-Gley soils studied. The fine silt fraction (2μ to 20μ) shows the same inverse relationship in Rowe, Bryce, and Ashkum but not in Drummer. No regular trend is found in the A or C horizons. Coarse silt (20μ-50μ) is highest in the Drummer profiles.

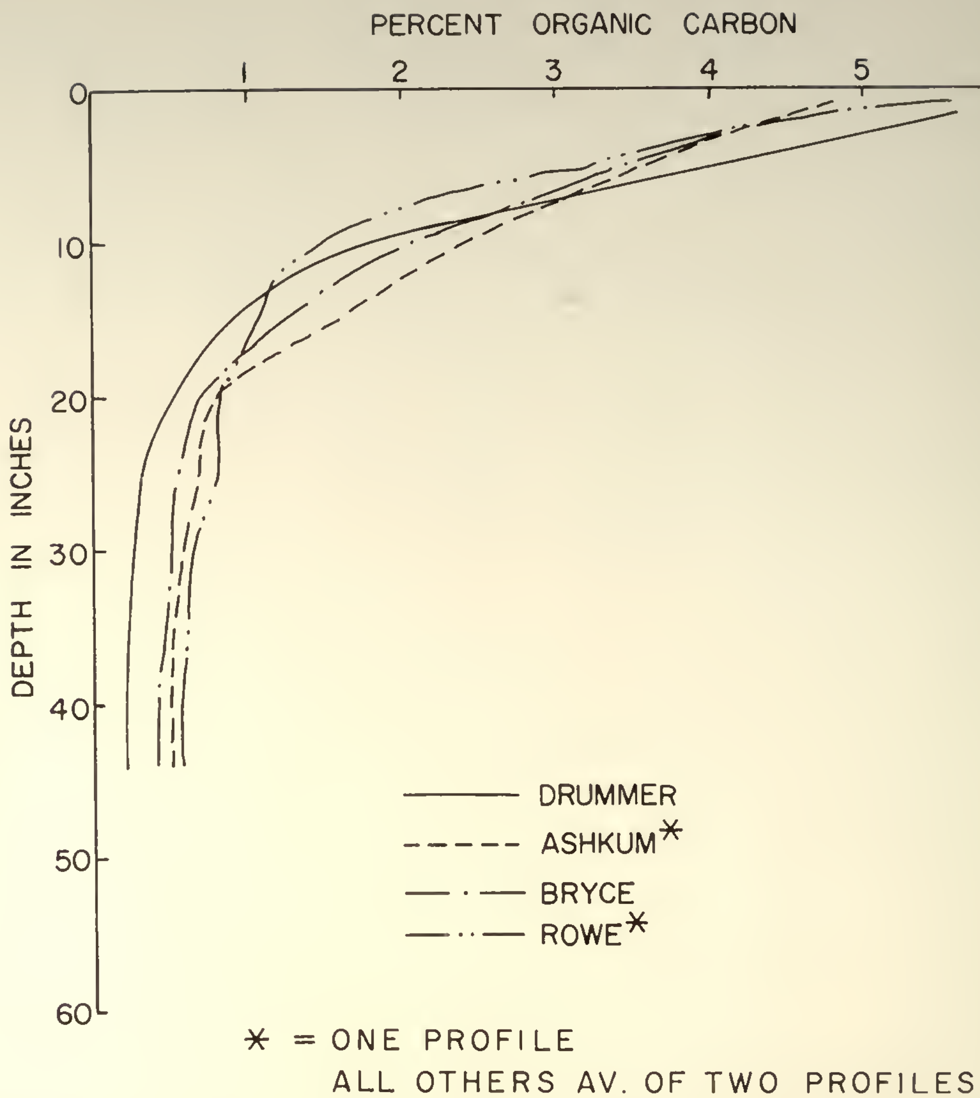
Chemical properties

Organic carbon is high in the surface few inches or upper part of the A horizon of Humic-Gley soils. It ranges between 3 and 6 percent (approximately 5-10 percent organic matter) in the upper 5 inches of the profiles studied. It decreases with depth to less than 1 percent at 20 inches (Fig. 21). Although Rowe is more grayish in color than Bryce, Ashkum, or Drummer it has about the same content of organic carbon.

The A horizon of these soils is slightly acid to neutral (pH 6.0-7.0); the B horizon is about neutral (pH 6.5-7.5); and the C horizons are calcareous. Of the profiles studied, Rowe is the most acid, particularly in the B horizon, with the lowest pH at the 18- to 27-inch depth. This fact along with the relatively greater depth to free carbonates in this fine-textured soil further indicates the possibility of local slopewash origin of the upper solum material. All profiles of Rowe are not this acid. Many are nearly neutral throughout the solum and some are calcareous as shallow as 30 inches or less.

The Humic-Gley soils studied have an average cation-exchange capacity of approximately 30 meq. per 100 gm. of soil in the A horizon and 20 meq. per 100 gm. in the B horizon (Fig. 22). This is higher than any of the Gray-Brown Podzolic soils studied and equaled by only a few Brunizems. This high absorptive capacity is 90 to 100 percent saturated with bases and these soils are considered highly fertile.

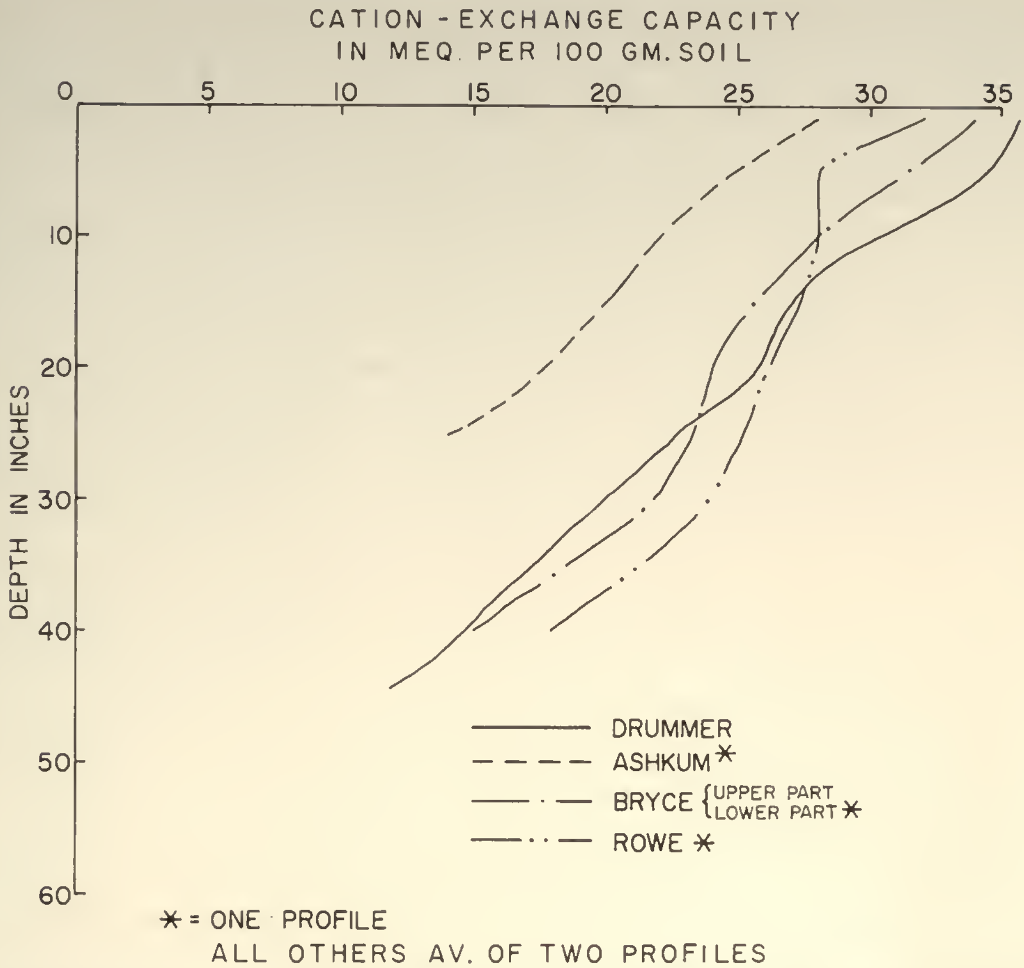
The exchange capacity in meq. per 100 gm. of soil seems to vary in an irregular manner and to be unrelated to the amount of clay present. However, the exchange capacity in meq. per 100 gm. of clay does vary



Distribution of organic carbon in some Humic-Gley soils in northeastern Illinois. (Fig. 21)

inversely with the amount of clay normally found in these soils and their parent materials. Thus the exchange capacity per 100 gm. of clay in the A horizon of the Rowe averages about 69 meq., Bryce, 74 meq., Ashkum, 81 meq., and Drummer, over 100 meq. That of the B horizon of Rowe averages about 46 meq., Bryce, 51 meq., Ashkum, 64 meq., and Drummer, 72 meq. This relationship is due to the kinds of clay minerals present (Table 6, page 49).

Exchangeable calcium is greater than 10 meq. per 100 gm. of soil throughout the sola of all of these soils except Rowe. Exchangeable magnesium is also greater than 10 meq. per 100 gm. of soil except in the Ashkum and one Drummer. However, magnesium tends to average lower than calcium and the Ca/Mg ratio is greater than 1:1 in all sola except the lower B horizon of Rowe.



Cation-exchange capacity of some Humic-Gley soils in northeastern Illinois. (Fig. 22)

Exchangeable potassium ranges primarily between 0.2 and 0.5 meq. per 100 gm. of soil. This is higher than the associated Gray-Brown Podzolic soils studied but lower than some of the Brunizems. Available potassium in pounds per acre as determined by quick test closely parallels exchangeable potassium. All A-horizon sampling layers and most B-horizon sampling layers of the Humic-Gley soils studied tested higher than 150 lb. per acre of available potassium. On the other hand, available phosphorus is low to medium in the sola as determined by both adsorbed and adsorbed plus acid-soluble methods, i.e., <30 lb. per acre and <70 lb. per acre, respectively.

Genesis

The sola of the two Drummer soils studied were derived primarily from outwash. This is indicated by the presence of stratified material beneath the B horizon. A small amount of loess seems to have also

contributed to the parent material of the sola either as direct wind deposition or as wash from adjacent loess-covered slopes. This is especially true of the McLean county Drummer (No. 29) because it was taken in an area where 2 feet of recognizable loessial material is present as parent material in adjacent Brunizem soils.

The upper part of the Ashkum, Bryce, and Rowe sola were primarily derived from local slope wash with an admixture of loess and the lower part probably from till. To what extent each material contributed to each solum could not be determined by field examination. Physical, chemical, and mineralogical data, however, strongly indicate that the sola of these soils were derived from material other than the respective tills although more or less directly related to them.

Use

The Humic-Gley soils in northeastern Illinois are fertile. They are high in organic matter, nitrogen, and available potassium. Most of them are about neutral in reaction but tend to be low in available phosphorus. Response to improved management is not as pronounced as with the associated Brunizem and Gray-Brown Podzolic soils.

Adequate drainage and maintenance of soil aggregation and good soil tilth are the most important problems in the farming of these soils. Permeability varies from moderate in Drummer to very slow in Rowe. Tile drawdown is good in areas of Drummer soils and tile lines function well, if outlets with sufficient fall are obtained. Tile drawdown is too slow in areas of Rowe for tiling to be economically effective.

Kidder and Lytle (1949) suggested that, for good drainage, gravitational or free water in the soil should be removed to a depth of 12 inches within the first 24 hours and to 21 inches within 48 hours. This is normally accomplished throughout a distance of 80 to 100 feet between tile lines in Drummer soils. It is not expected throughout more than about 40 or 50 feet in Ashkum, 20 to 25 feet in Bryce, and 10 to 15 feet in Rowe. Tiling is recommended as economically feasible in Drummer and Ashkum, questionable in Bryce, and uneconomical in Rowe.

Although natural variations occur in all of these soils, permeability depends on management practices as well as on the soil type. Adequate drainage often results in better aeration and in improved granulation or aggregation. These result in better soil tilth and better plant growth. Good legume-grass sod crops help increase pore space and provide root channels for further improvement in drainage and aeration.

SOIL DEVELOPMENT, CLASSIFICATION, AND CORRELATION

Development

In the geological time scale the three major groups of soils in northeastern Illinois — Gray-Brown Podzolic, Brunizem, and Humic-Gley — are very young. With no known Mankato-age or later loess reaching northeastern Illinois, except possibly a few inches from local sources, the soils for which data were obtained in this study have been weathering since late Tazewell and early Cary (middle Woodfordian) time. This is an estimated 13,000 to 18,000 years by radiocarbon dating or 25,000 years or slightly more according to geological evidence. Both are considered relatively short geological periods.

Regardless of the actual number of years that have passed, the soils are in various stages of weathering and development, ranging from moderately developed to moderately well developed. It is believed that these various stages of development were reached concurrently and that differences among the soils in rate of weathering were governed by differences in permeability, relief, and native vegetation.

Importance of parent material. Parent material is the most important factor in the early stages of soil formation. As development progresses, characteristics that result from the effects of climate, drainage, and organisms gradually assume more importance. These features become more strongly impressed as weathering continues and the soils age, but they can be altered by a change in environment. On the other hand, those features indigenous to kind of parent material tend to remain throughout the life history of most soils.

In a geologically young region, such as northeastern Illinois, the composition of the various till, outwash, and loess materials is of primary importance in the development of the existing soils and is useful in characterizing many of the principal soil series. Areas of very young or very weakly developed soils, e.g., Regosols (see key to soil series, in pocket inside back cover) occur on steep slopes in which leaching of carbonates has scarcely exceeded erosion. The solum is less than 10 to 18 inches thick and the horizons are few and indistinct. Kind of parent material is the dominant feature in these thin-solum soils.

In the three major groups of soils (Gray-Brown Podzolic, Brunizem, and Humic-Gley) features resulting from organic-matter accumulation serve to differentiate the Gray-Brown Podzolics from the Brunizems and the Humic-Gleys. But within each group, parent material is still the most important factor. By its variable physical composition and resulting variable permeability it governs not only oxidation

or drainage features but also thickness of the horizons and of the solum and, to a degree, profile development (Stauffer 1935). Even in the most strongly developed soils in this region, i.e., Planosolic intergrades (see key to soil series, in pocket inside back cover), in which the easily weatherable minerals and the plant nutrient elements occur in small amounts and several very distinct horizons have formed, parent material still influences the thickness of the various horizons and thickness of solum. It is also of considerable importance in the use, management, and productivity of the various soil series.

Kinds of soil parent materials. Loess is the surface material throughout a large portion of the region studied (Fig. 9). Beneath the loess or where no loess is present various till and outwash materials of Wisconsin glacial age occur singly and in combination to form a complex pattern of soil parent materials.

Loess more than 2 feet thick, except where removed by erosion, is recognized on most of the till and outwash areas in the western three-fifths of the region studied (see colored map, in pocket inside back cover). A few inches are undoubtedly present in a gradual eastward thinning from the 2-foot depth line but positive identification is very difficult or impossible. In the descriptions in Appendix A the possible presence of loess is suggested several times but more positive identification is indicated in only five of the profiles sampled. Also, a check of the chemical data (Appendix C) and the mineralogical data of the sand fractions (Appendix D and Table 7) shows no obvious differences among loess, till, and outwash. Apparently the initial differences in chemical and mineralogical properties among loess, till (particularly medium-textured till), and outwash is mostly obliterated through mixing by soil fauna and soil development. It is primarily in the proportions of sand, silt, and clay and in the mineralogy of the clay fraction, though also sometimes in the mineralogy of the silt fraction, that measurable differences exist.

Calcareous till varies gradually and regularly in mechanical composition from clay to gravel but is divided into six textural groups for soil-mapping purposes (see colored map, in pocket inside back cover). In many areas free calcium carbonate has not leached to a depth of more than 2½ feet, whereas in other areas leaching has reached a depth of 4 feet or more. This difference in depth of leaching in comparable materials is a reflection of relative soil age, but in contrasting textures of materials it is a reflection of permeability.

Water-deposited materials also vary in particle-size distribution from clay to gravel. Because of physical similarity the clay and silty

clay textured lakebed sediments are combined on the colored map (in pocket inside back cover) with the corresponding till-texture groups. Also the gravelly water-deposited material is included with the loamy gravel till group because water sorting was important in many high gravelly morainic knobs as well as in the formation of eskers, gravelly terraces, and outwash plains. Sandy loam to sand, loam, silt loam, and silty clay loam outwash materials are separated from tills of comparable texture because stratification of two or more of these medium-textured materials is more widespread and more prominent than in the very coarse and very fine textures.

Organic materials and alluvial sediments are important soil parent materials in the region. Limestone and sandstone bedrock and residuum are very minor in occurrence and in most areas are buried beneath loess, till, or outwash sediments.

Influence of climate. Fluctuations of postglacial climate from cool to warm, moist to dry, and vice versa, are indicated by studies of peat bogs, lake and ocean shore lines, oscillations of mountain glaciers, and other geological features. A warm and dry period of perhaps 2,000 years duration seemingly occurred between about 5000-4000 and 3000-2000 B.C. (Flint, 1947). It is probable that this period, along with more recent but shorter dry periods, may be responsible for the wide extent of prairie in northeastern Illinois and the resulting Brunizem soils. However, recent observations and other information indicate that under the present continental type of climate in the humid midwest, forests were encroaching on the prairies with a change in soil features to an eventual Gray-Brown Podzolic climax. This encroachment was halted by man.

Regardless of past temperature and rainfall fluctuations the net climatic effect in the soils in northeastern Illinois was (1) leaching of calcium carbonate from the A, B, and upper C horizons, (2) slight to moderate removal of bases from the A and B horizons and replacement by equivalent amounts of hydrogen, (3) slight to moderate removal of iron and aluminum from the sola and a proportionate increase in silicon, and (4) moderate amounts of fine-clay formation and accumulation in the B horizon.

Influence of drainage conditions. The combined influence in this region of topography, permeability of parent material, and depth to a fluctuating water table has produced a range in soil-profile color from an overall gray (i.e., very poorly oxidized or very poorly drained) to an overall yellowish-brown (i.e., well oxidized or well drained). Be-

tween these extremes, various combinations of gray and yellowish-brown, including mottlings, occur so that poorly oxidized, imperfectly oxidized, moderately well-oxidized, and well-oxidized soil profiles are recognized though not always mapped (see key to soil series, in pocket inside back cover).

Poorly oxidized soils developed in those areas where the water table was at the surface regardless of permeability of the material, e.g., Will silty clay loam. Also those soils that developed from fine-textured, nearly impermeable materials in which air and water move very slowly are poorly to imperfectly oxidized regardless of slope or depth to water table, e.g., Clarence silt loam. Coarse-textured, rapidly permeable soils with a deep water table are well oxidized regardless of slope, e.g., Fox silt loam. Only in medium-textured, moderately permeable materials, where air and water movement is relatively free and the water table is normally deep under high narrow ridges and shallow in the footslopes and depressions, are the catenas or soil-drainage sequences complete.

Influence of vegetation and organisms. The kind of native vegetation, including all associated plant and animal life, occupying each area for a considerable time was responsible for certain distinguishing characteristics in the soils of northeastern Illinois. Without some form of permanent vegetative cover little or no organic matter would have accumulated and no soil horizons resulting from it would have formed.

Two sharply contrasting kinds of native vegetation, tall-grass prairie and deciduous hardwood forest, occupied the landscape when settlers first entered the region in the late eighteenth and early nineteenth centuries. Wet prairie or marsh vegetation as well as shallow lake and bog vegetation were also present but are included with prairie in this discussion.

The net effect on all soils of both kinds of vegetation was an accumulation of organic matter on the surface and within the topsoil layer. This accumulation is probably somewhere near its maximum for the conditions under which most of the "prairie" soils developed but probably has reached maximum for the "forest" soils and is declining.

Soils covered with prairie vegetation developed thick, very dark brown to black A_1 horizons in which the darkness fades gradually below 10 to 12 inches through a weakly developed or nonexistent A_3 into the B horizon. These soils are distinguished on the colored map (in pocket inside back cover) by the subscript A in the symbol. Soils covered with forest vegetation developed thin dark gray to brown or black A_1 horizons in which the dark colors change abruptly to light

colors at the contact with a well-developed, moderately thick A_2 horizon. Areas of these soils are indicated by the subscript B in the symbol on the colored map.

In many places between the prairie and forest areas a narrow belt of combined tree and grass vegetation was present. It is thought that in most of these areas forest was encroaching on prairie when the process was halted by clearing and cultivation. Soils in these areas have a somewhat thicker dark-colored A_1 and a relatively thinner light-colored A_2 than the associated Gray-Brown Podzolics. They are often difficult or impossible to distinguish from Brunizem-Planosol intergrades. Areas of these soils large enough to show on the colored map occur only on the Valparaiso moraine in Will and Cook counties. They are indicated by the subscript C in the map symbol.

Degree of weathering. In certain areas, under an environment in which either weathering was slow or soil material was being continually removed, very young or very weakly developed soils are present. In a nearby area, under another environment in which erosion or deposition was negligible and weathering was rapid, the solum formed rapidly and soils of relatively advanced development are present.

Where undisturbed by man and untreated, the Brunizem and Humic-Gley soils of northeastern Illinois have probably reached a near-maximum accumulation of organic carbon in the A_1 horizon for their respective environments (Figs. 18 and 21). With continued weathering the organic-carbon content may be expected to decline, particularly in the lower A horizon. This will tend to occur sooner in the Brunizems, particularly the imperfectly to poorly oxidized members, than in the Humic-Gleys. In a few soils classified as Brunizem-Planosol intergrades, the loss in organic carbon from the lower A horizon is already evident, e.g., Thorp and Monee series (see key to soil series, in pocket inside back cover).

The sola of both Brunizem and Humic-Gley soils are only slightly below 100 percent saturated with bases. The proportion of clay in the B horizon of the poorly and imperfectly oxidized members has probably not reached the maximum. It may have reached the high point in the well-oxidized members. In these latter soils continued clay formation may only result in a thicker textural B horizon. With an increase in clay the capacity to hold bases in the solum increases, but this tends to be offset and will eventually be overbalanced in the A by a decrease in organic-matter content. Also, eventually, the rate of mineral weathering and replenishment of exchangeable bases will decrease.

Under a virgin environment the Gray-Brown Podzolic soils appear to have already reached their maximum organic-carbon accumulation in the A horizon and are declining. They have probably also reached a maximum organic-carbon accumulation in the B horizon (Fig. 10). The level of exchangeable bases for the sola as a whole is declining. Although the capacity to hold bases may increase somewhat in the B horizon, because of increasing clay content, the capacity in the A and rate of base release appears to be declining. Maximum percent clay accumulation probably has not been reached in the poorly and imperfectly oxidized catena members. It may have been reached in the well-oxidized members.

As mentioned earlier, the soils of northeastern Illinois are in various stages of development. A comparison of their measurable characteristics (movement of clay and bases) indicates that the Gray-Brown Podzolic soils are relatively more weathered and more developed than the Brunizems, and the Brunizem soils are relatively more weathered and developed than the Humic-Gleys.

Classification

Slightly more than 100 soil series are established and are being mapped in northeastern Illinois at this date, excluding alluvial, organic, and deep-loess soils and those underlain with bedrock or residuum at depths of less than 5 feet. Some additional series are recognized and are being mapped, but are not yet correlated.

Most of the soils in northeastern Illinois are monotype series with a silt loam A horizon due to the covering of loess over much of the region. The Humic-Gley soils usually have a silty clay loam surface texture. The variable thickness of loess and the large variety of till and outwash materials are primarily responsible for the large number of series that occur.

The soils in northeastern Illinois may be classified in numerous ways according to the sought-after objectives. The principal classifications used in organizing and presenting material in this bulletin are (1) parent material of the soils and (2) Great Soil Group.[1]

Parent material. A grouping by parent materials, combined with a grouping by surface color, was used in constructing the colored map (in pocket inside back cover). The soils included in each group on this map occur in close geographic association over relatively wide

[1] A new system of soil classification is being developed by the U.S.D.A. Soil Survey. In the seventh approximation (1960) of this system, the terms *Typudalf, Argudoll,* and *Haplaquoll* correspond respectively to Gray-Brown Podzolic, Brunizem, and Humic-Gley, as used in this publication.

areas. They were developed in similar parent material and under a cover of similar vegetation. They have approximately the same number and sequence of horizons but differ in oxidation or drainage profile. In general they form a soil catena as defined by Bushnell (1944). Certain soil series, usually one to three or more, on each line in the key (in pocket inside back cover), are considered a catena (e.g., Varna, Elliott, and Ashkum). Figures 23 to 28 show graphically the relationship of the important soil types associated with till in northeastern Illinois to parent material, topography, and native vegetation.

Influence of loess. Soil separations based on variable thickness of the loess cover on till and outwash of Wisconsin glacial age have been made for a number of years. From time to time such separations were questioned, particularly those in which till and outwash of loam and silt loam textures occurred beneath the loess.

The first available information to indicate possible important differences between loess and till of loam to silt loam texture was from field observations. These observations indicated that, on similar slopes and under similar management, erosion was more rapid and difficult to control on soils derived from till than on soils derived from deep loess. Recent data indicate that this is probably true because till is more compact and more dense than loess. Determinations made for this and related studies show that the bulk density of unleached till of loam texture ranges primarily between 1.75 and 1.85, whereas that of unleached loess ranges between approximately 1.40 and 1.50.

DeTurk (1942) pointed out that till-derived soils contained less readily available phosphorus than loess-derived soils, and Smith (1950) showed that crops grown on Brunizem soils derived largely from till responded more to applications of rock phosphate than those grown on loess-derived soils.

Also clay-mineral determinations for this and related studies show that little or no montmorillonite is present in the calcareous till in northeastern Illinois, though present in small amounts in the leached portion, but it is the predominant clay mineral in both leached and calcareous loess. Thus these studies indicate that soil separations in this region based on the presence of a significant amount of loess as contrasted to its absence are sound.

Great Soil Groups. A grouping by Great Soil Group is the principal classification used in the discussion of the soils studied (pages 57 through 86). The soils included in each of these groups have the same number, kind, and sequence of horizons. They have a similar degree of oxidation or coloration, except for broader inclusions in the Gray-

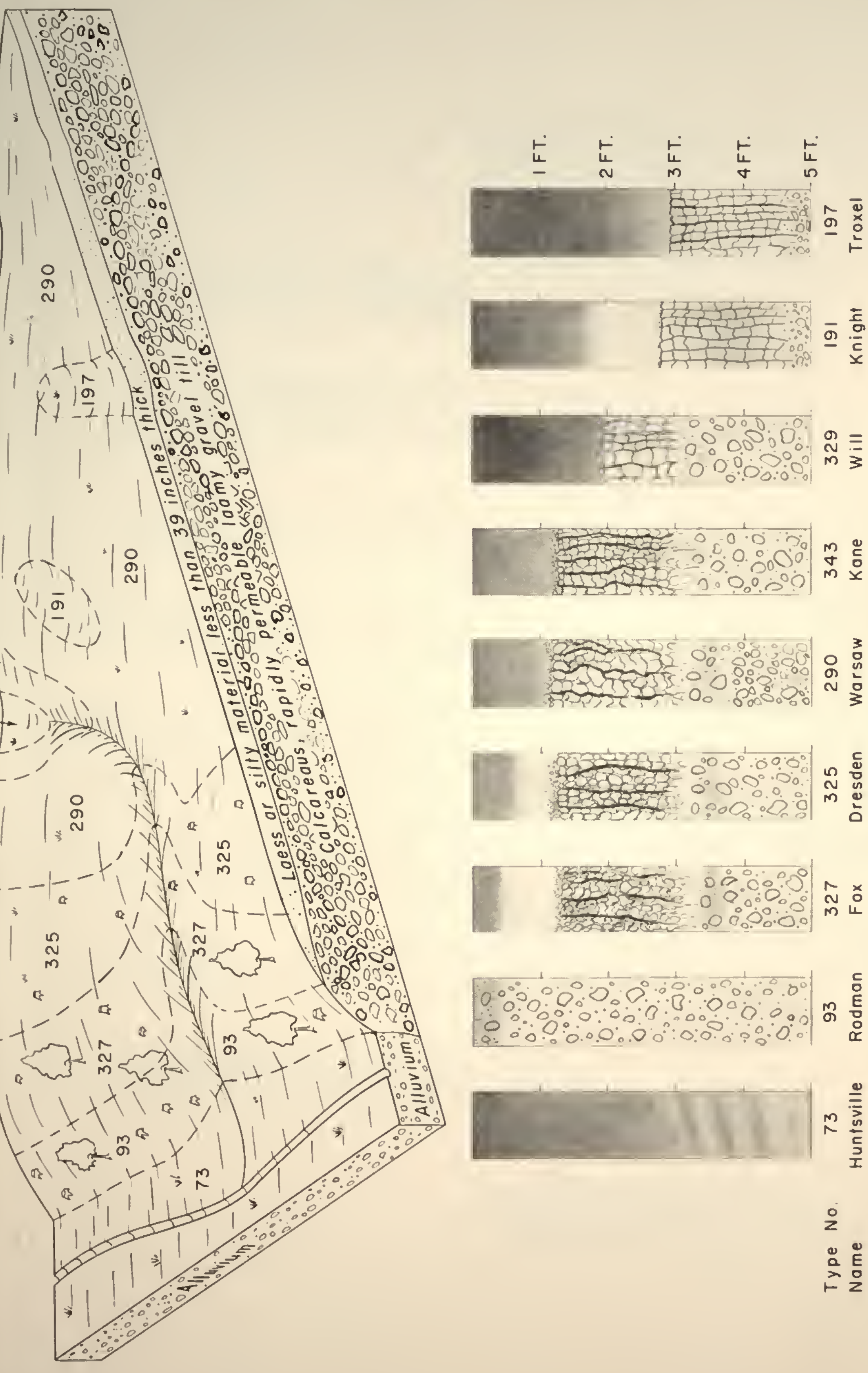
Brown Podzolics and Brunizems as previously explained (pages 58 and 71). They were derived from variable parent materials and ordinarily do not occur in close geographic association. In general the column headings in the key to soil series (in pocket inside back cover) are by Great Soil Group, except that the imperfectly oxidized series are usually considered "drainage intergrades."

Correlation

Soil correlation is the act or process of relating the features of one soil to another. It is based primarily on observable morphological characteristics but supplemented in many cases by other detectable properties.

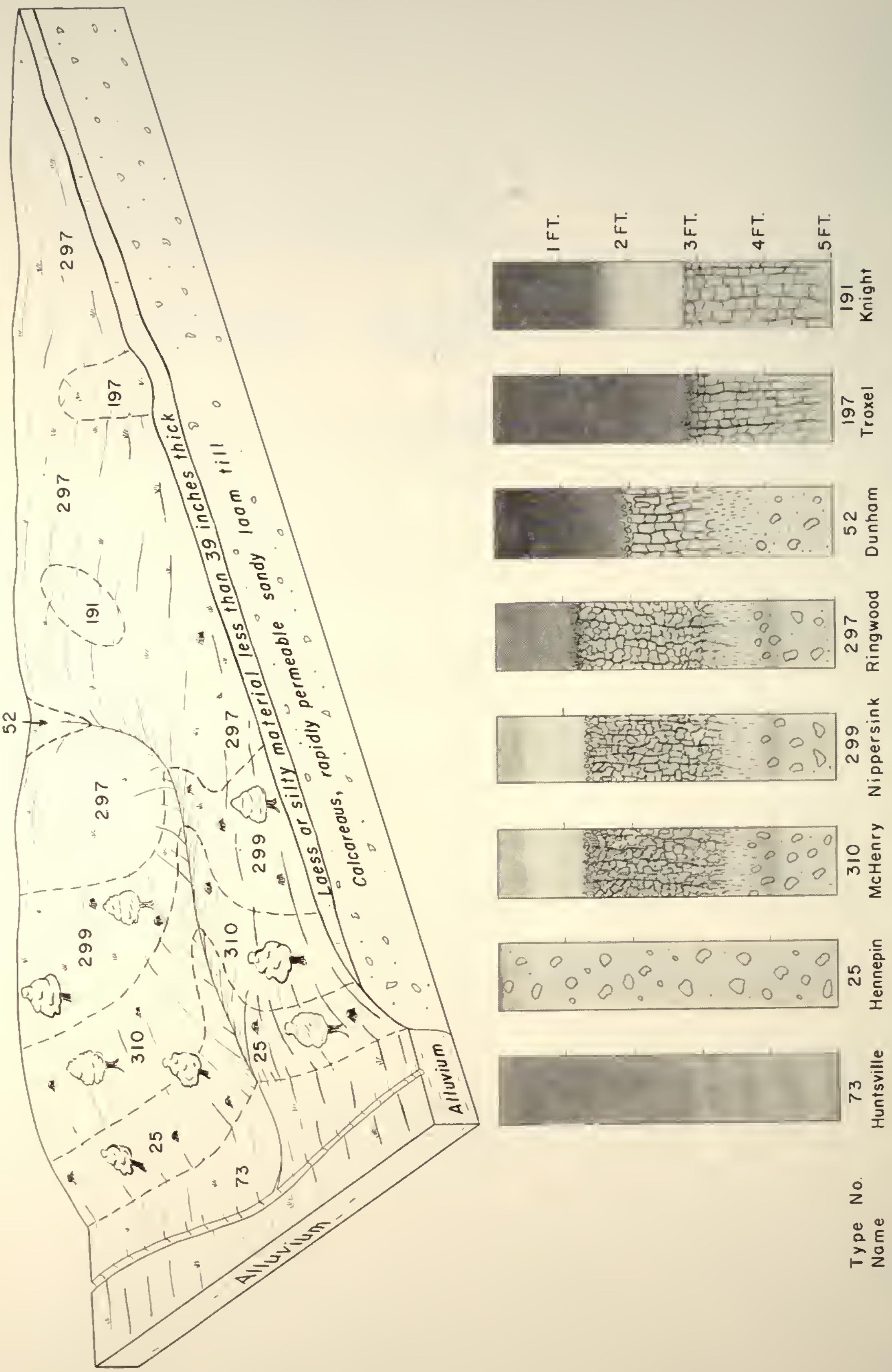
In north-central and northeastern United States in areas of youthful Wisconsin-age, till-derived soils, sound soil correlation requires that emphasis be placed on character of the C-horizon till as well as on the sola. A thin cover of loess or other surficial material may result in similar A and/or B horizons over broad areas; nevertheless, the C horizons may have highly important but widely different characteristics.

About 40 of the more than 100 soil series established to date in northeastern Illinois are correlated in adjacent states. Recognition of different oxidation or drainage classes, different till textures, different loess thicknesses, different depths of leaching, and other features makes the problem of correlation difficult. A clearer understanding of the differentiating characteristics between kinds of soils as well as clearer, more precise, and more complete soil profile descriptions, would aid materially in proper correlation. Data such as are reported in this publication help to characterize soil series more completely and accurately and, therefore, facilitate proper correlation with similar soils within Illinois and in neighboring states.



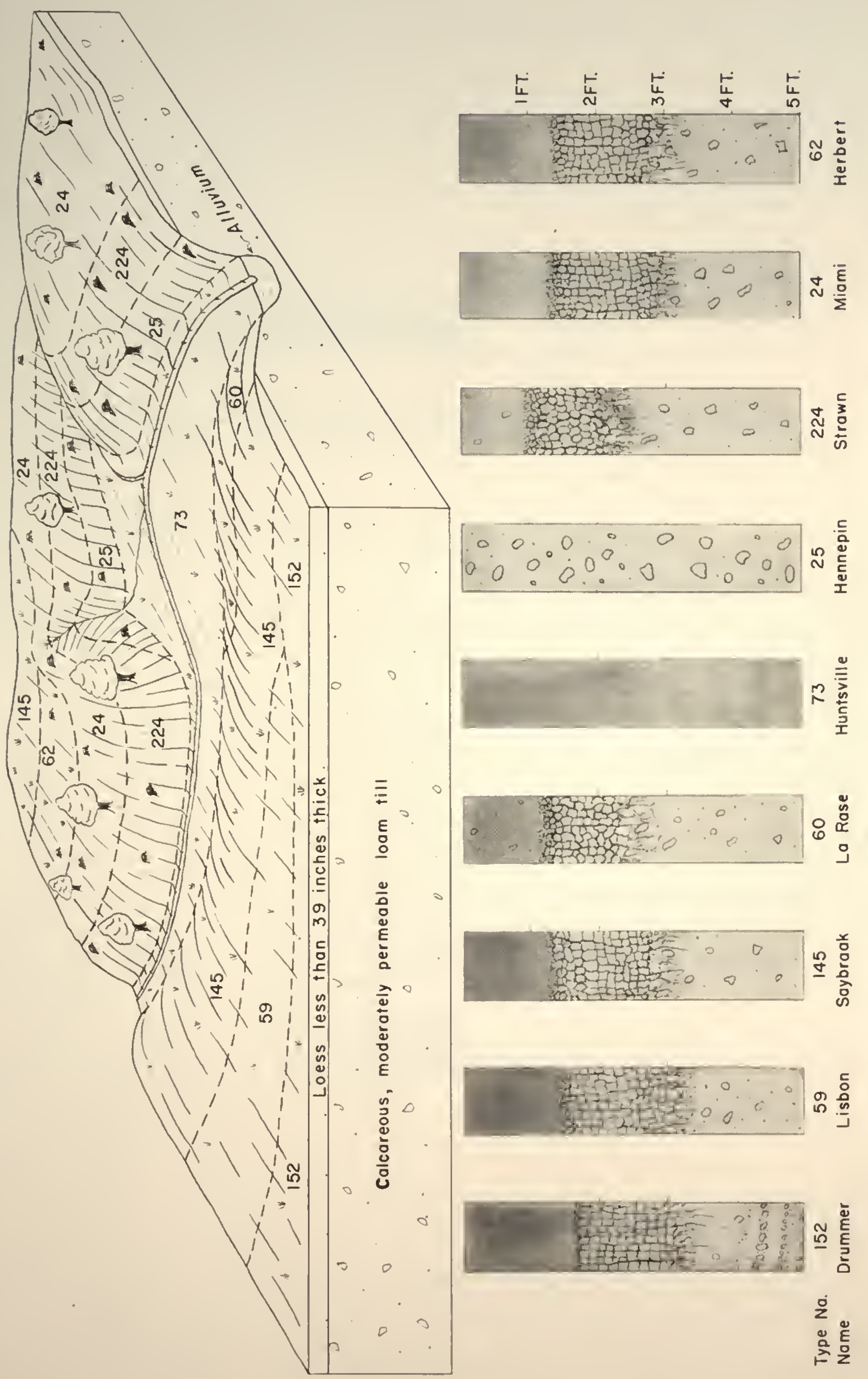
RELATIONSHIPS OF SOILS ASSOCIATED WITH THE WARSAW AND FOX SERIES

(Fig. 23)



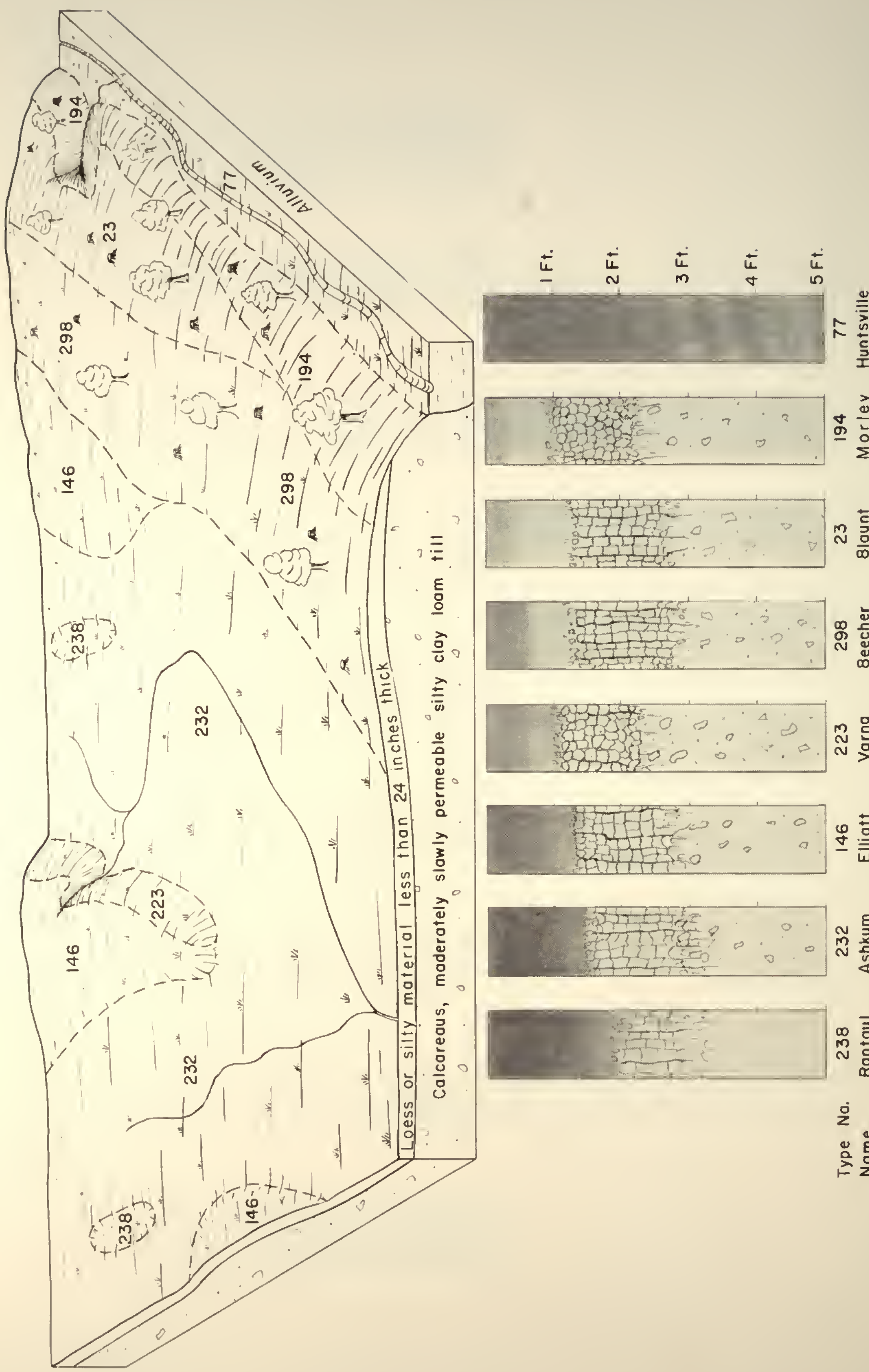
RELATIONSHIPS OF SOILS ASSOCIATED WITH THE RINGWOOD AND McHENRY SERIES

(Fig. 24)



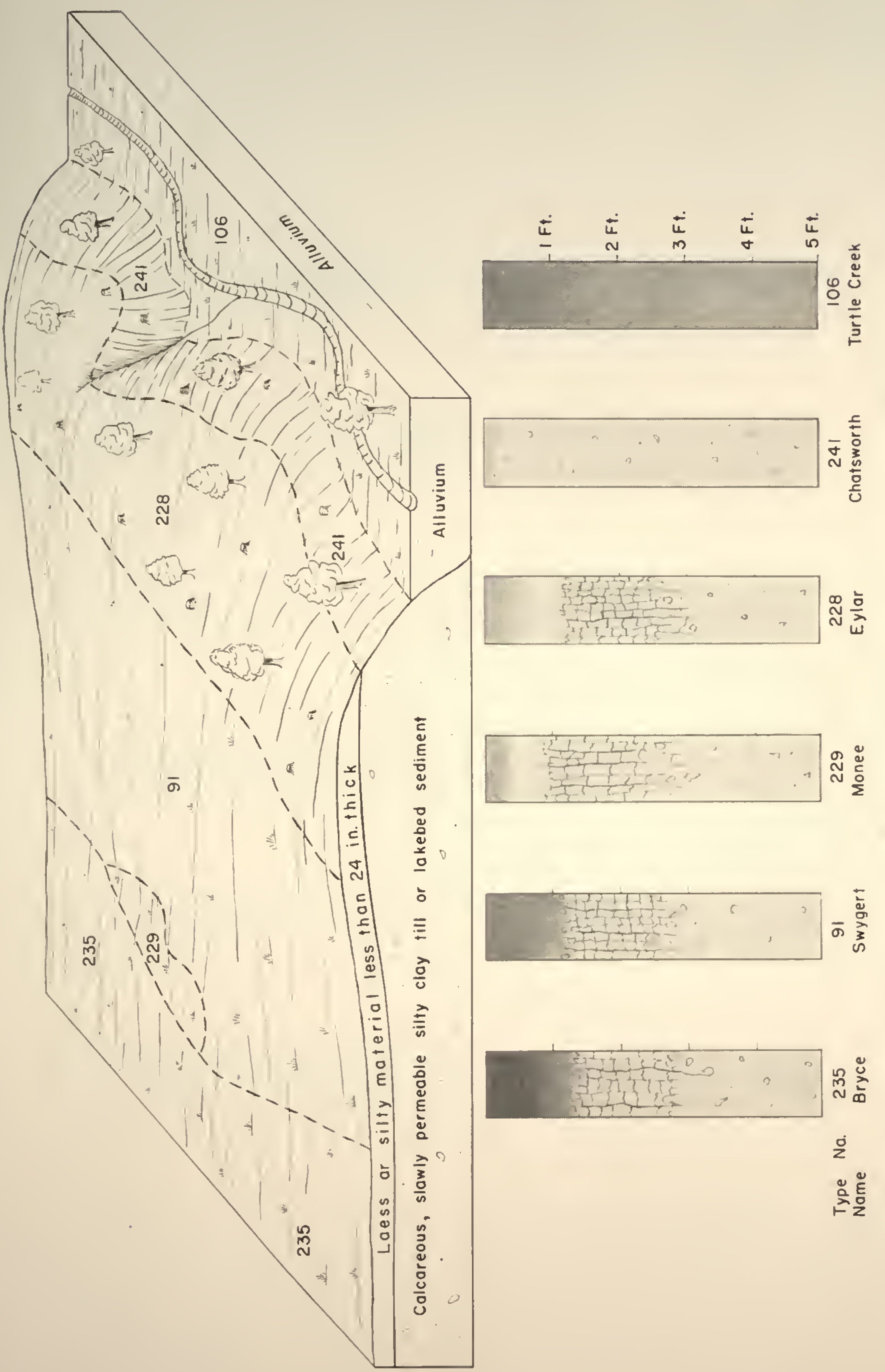
RELATIONSHIPS OF SOILS ASSOCIATED WITH THE SAYBROOK AND MIAMI SERIES

(Fig. 25)



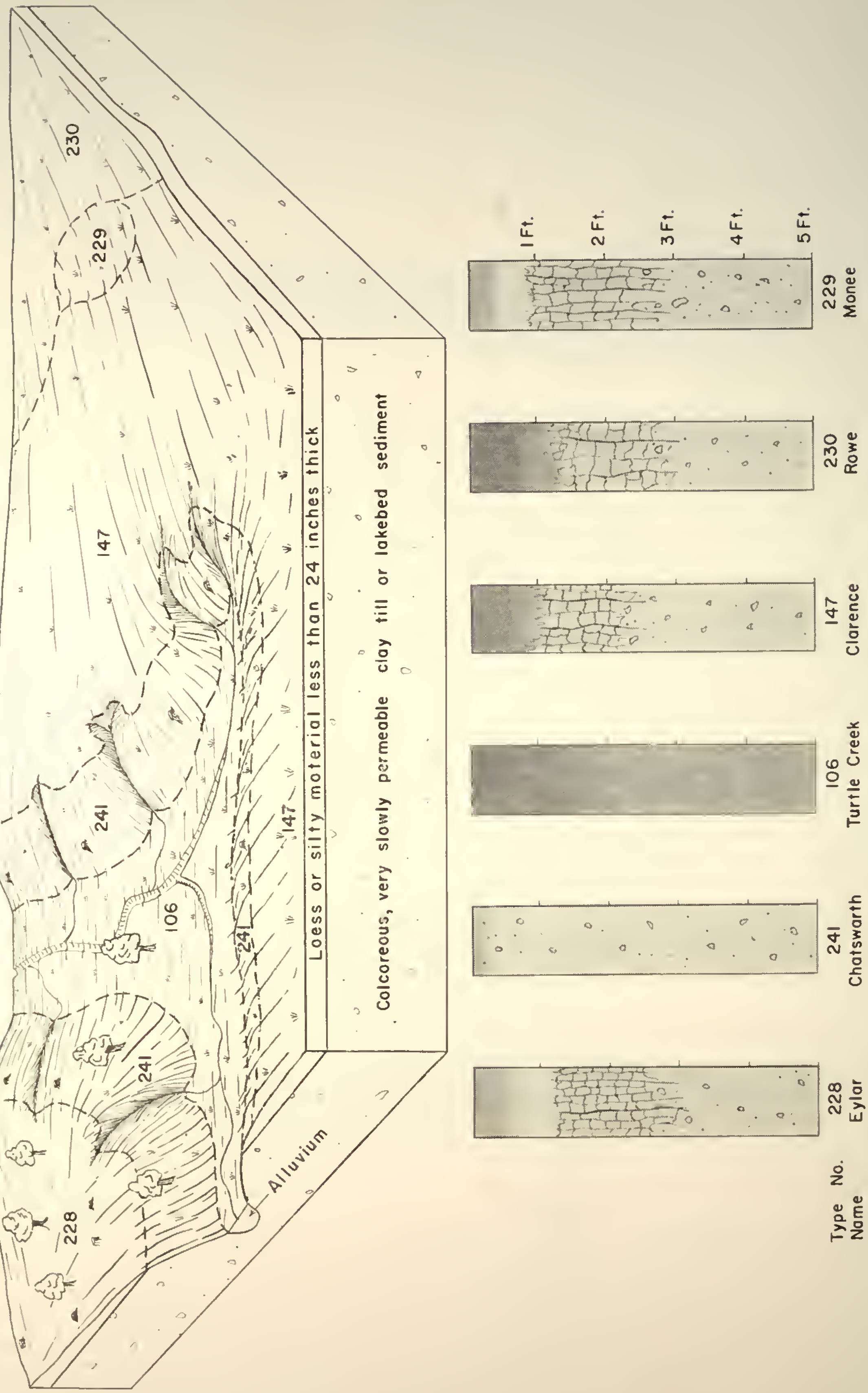
RELATIONSHIPS OF SOILS ASSOCIATED WITH THE ELLIOTT AND BLOUNT SERIES

(Fig. 26)



RELATIONSHIPS OF SOILS ASSOCIATED WITH THE SWYGERT AND EYLAR SERIES

(Fig. 27)



RELATIONSHIPS OF SOILS ASSOCIATED WITH THE CLARENCE AND EYLAR SERIES

(Fig. 28)

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APPENDIX A: DETAILED PROFILE DESCRIPTIONS

Munsell color notations are from freshly exposed, moderately moist soil material unless otherwise stated. Textures given are those determined in the field and do not always coincide with laboratory data.

The number in parentheses following each soil type name is the Illinois soil type number.

Profile No. 1 — Fox silt loam (327)

McHenry county, T44N, R7E, Sec. 11, NW¼, SW40, SE10. Samples taken from edge of old gravel pit on side of convex ridge on 10-percent slope to east. Parent material to a depth of 22 inches may be silt loam drift or partly late Peorian loess, at 22 to 27 inches is leached till, and below 27 inches is calcareous loamy gravel till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated roadside sod along a formerly gravelled (presently blacktop) road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

Horizon	Depth *(inches)*	Sample No.	
A_1.......	0–5	17746	Very dark brown (10YR 2/2) crushing to very dark grayish-brown (10YR 3/2) friable silt loam; fine crumb to granular structure; many fibrous roots; many worm burrows.
A_2.......	5–10	17747	Brown (7.5YR 5/4) friable silt loam, with a very few pebbles; fine to medium crumb structure; numerous fibrous roots; many worm burrows, some filled with dark A_1 material.
A_3–B_1....	10–13	17748	Brown (7.5YR 5/5) silty clay loam borderline to silt loam with a very few pebbles; very fine subangular blocky structure; numerous roots; many worm burrows, some filled with dark A_1 material.
B_2.......	13–17 17–22	17749 17750	Brown (7.5YR 4.5/4) silty clay loam with some sand and pebbles; very fine to fine subangular blocky structure; many fibrous roots; few worm burrows, some with organic linings.
B_3.......	22–27	17751	Brown (7.5YR 4/4) sticky clay loam borderline to clay with numerous small rounded pebbles; fine angular blocky structure; few roots; few worm burrows; some yellowish-red (5YR 4/6) iron splotches.
C_1.......	27–38	17752	Primarily light yellowish-brown (10YR 6/4) partly weathered limestone rocks and pebbles with channels of brown (7.5YR 4/4) fine-textured B_3 material; a few dark-colored partly weathered igneous rocks; a few roots; boundary to layer below is wavy and irregular.
C_2.......	38–50+	17753	Predominantly brown (7.5YR 5/5), but with lighter- and darker-colored pebbles, loose calcareous loamy gravel till; single grain; dominantly more rounded rocks and pebbles and probably less limestone than C_1.

Profile No. 2 — Fox silt loam (327)

McHenry county, T46N, R8E, Sec. 21, NW¼, SE40, SW10. Pit for sampling dug at crest of convex ridge on 3-percent slope to west. Material to a depth of

13 inches is silt loam drift which may be partially loess of late Peorian age on leached drift 13 to 33 inches deep. Below 33 inches is loose, calcareous, loamy fine gravel drift of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated roadside sod along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

Horizon	Depth *(inches)*	Sample No.	
A_1.......	0–5	17833	Very dark brown (10YR 2/2) silt loam with some sand; numerous fibrous roots.
A_2.......	5–8	17834	Dark brown (7.5YR 3/3) silt loam borderline to clay loam with much coarse sand; many fibrous roots; many worm burrows, some filled with dark A_1 material.
B_1.......	8–13	17835	Dark brown (6YR 3/4) clay loam or silty clay loam with some coarse sand and a few small pebbles; many fibrous roots; a few worm burrows filled with dark A_1 material.
B_2.......	13–18 18–24	17836 17837	Dark brown (6YR 3/4) sticky clay loam; coarse sand and small pebbles throughout but more numerous in lower part; occasional crack or face of very large aggregate but no definite structure noticeable; few fibrous roots; a very few earthworm burrows.
B_{31}......	24–32	17838	Dark brown (6YR 3.5/4) sandy loam or loamy sand with some small pebbles; a few fibrous roots; a very few worm burrows.
B_{32}......	32–33	Not sampled	Dark reddish-brown (6YR 3/5) loamy coarse sand; a few fibrous roots.
C.......	33–45+	17839	Varicolored sand grains and pebbles with overall color of about brown (10YR 5/3) loose coarse sand and fine gravel with a few larger stones; calcareous.

Profile No. 3 — Fox silt loam (327)

McHenry county, T44N, R9E, Sec. 6, NE¼, SE40, NW10. Pit for sampling dug on crest of narrow convex ridge on 3-percent slope to northeast. Probably little or no loess at this site. Leached loam or silt loam till to a depth of 30 inches on calcareous loamy gravel till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated roadside brushy sod along a gravelled private road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_1.......	0–3	17840	Very dark brown (10YR 2/1.5) loam to silt loam; weak fine to medium crumb structure; many fibrous roots.
A_2.......	3–7	17841	Brown (10YR 4.5/3) loam to silt loam; weak very fine platy in place, breaking into weak fine to medium crumb or granular structure; many fibrous roots; numerous worm burrows filled with very dark brown (10YR 2/2) silt loam from A_1.
A_3.......	7–9	17842	Brown (7.5YR 4/4) loam or loam borderline to clay loam; weak very fine platy in place, breaking into weak medium granular structure; many fibrous roots.

Horizon	Depth *(inches)*	Sample No.	
B_1.......	9–13	17843	Brown (7.5YR 4.5/4) clay loam borderline to loam; weak fine to medium subangular blocky structure with some very thin clay coatings of brown (7.5YR 5/4).
B_{21}......	13–21	17844	Brown (7.5YR 4/4) clay loam borderline to clay with a few small pebbles; moderate fine to medium subangular blocky structure; some fibrous roots.
B_{22}......	21–27	17845	Brown (7.5YR 4/4) clay loam borderline to clay with some small and medium pebbles and more sand than B_{21}; moderate fine to medium subangular blocky structure with dark reddish-brown (5YR 2/2) discontinuous coatings; many fibrous roots.
B_{23}......	27–30	17846	Dark reddish-brown (5YR 3/3.5) spotted with dark reddish-brown (5YR 2/2) clay loam borderline to clay with many small and medium pebbles; moderate medium to coarse subangular blocky structure; few roots; some disintegrating pebbles colored light yellowish-brown (10YR 6/4) to yellow (10YR 7/8).
B_3.......	30–37	17847	Dark reddish-brown to reddish-brown (5YR 3/4-4/4) gravelly clay loam between pebbles and small stones of various colors; massive; very few roots; gravels primarily 1 to 2 inches in size but some up to 10 inches with a high percentage of limestone.
C.......	37–50+	17848	Mostly light yellowish-brown (10YR 6/4) loose loamy gravel till; calcareous.

Profile No. 4 — McHenry silt loam (310)

McHenry county, T46N, R6E, Sec. 3, SE¼, NE40, SW10. Pit for sampling dug on convex ridge on 5-percent slope to southeast. Parent material is probably loess of late Peorian age to a depth of 27 inches on leached till 27 to 37 inches deep. Below 37 inches is calcareous sandy loam till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated roadside along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_1.......	0–4	17768	Very dark gray (10YR 3/1) friable silt loam; granular structure; numerous fibrous roots; numerous earthworm burrows.
A_2.......	4–13	17769	Brown to pale brown (10YR 5/3-6/3) friable silt loam; weak platy structure; numerous fibrous roots; occasional dark organic streaks along root channels.
B_1.......	13–17	17770	Dark yellowish-brown (10YR 4/4) silty clay loam borderline to silt loam; weak very fine to fine subangular blocky structure; numerous fibrous roots; occasional small pebble.
B_{21}......	17–27	17771	Brown (10YR 4/3) silty clay loam; fine subangular blocky structure with few very dark grayish-brown (10YR 3/2) organic coatings; few fibrous roots; some pebbles.

Horizon	Depth *(inches)*	Sample No.	
B_{22}......	27–33	17772	90% brown (7.5YR 4/4) and 10% very dark grayish-brown (10YR 3/2) clay loam; moderate medium to coarse subangular blocky structure; few fibrous roots; some pebbles and small stones.
B_3.......	33–37	17773	90% brown (7.5YR 4/4) and 10% dark brown (7.5YR 4/2) clay loam borderline to loam; very weak coarse subangular blocky structure; some fibrous roots; many pebbles and small stones.
C.......	37+	17774	Brown to yellowish-brown (10YR 5/3-5/4) very friable sandy loam; massive; calcareous; numerous pebbles and stones.

Profile No. 5 — McHenry silt loam (310)

McHenry county, T46N, R7E, Sec. 36, NW¼, SW40, SW10. Pit for sampling dug on north slope of 5 percent on side of broad, gently convex ridge. Parent material to a depth of 16 inches is probably loess of late Peorian age on leached till 16 to 31 inches deep. Below 31 inches is light brown loam to sandy loam calcareous till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation is primarily oak-hickory forest. Sampled in uncultivated woods.

A_1.......	0–2	17824	Black (10YR 2/1) silt loam with a little sand; a few intrusions of gray silty material, probably A_2 material; numerous medium to fine roots.
A_{21}......	2–4	17825	Dark gray (10YR 4/1.5) silt loam; some small roots; numerous worm burrows filled with dark A_1 material.
A_{22}......	4–7	17826	Dark grayish-brown (10YR 4.5/2) silt loam; very fine to fine platy structure; some small roots.
A_3–B_1....	7–9	17827	Brown (10YR 4/3) silt loam borderline to silty clay loam; fine granular to very fine subangular blocky structure; some roots.
B_{21}......	9–16	17828	Brown (10YR 4/3) silty clay loam with a little sand; fine subangular blocky structure with some thin coatings of grayish-brown (10YR 5/2) silty material; a few medium to fine roots.
B_{22}......	16–22 22–28	17829 17830	Reddish-brown (6YR 4/4) clay loam borderline to clay; medium subangular blocky structure with some smooth clay film coatings; a few roots and a few small pebbles.
B_3.......	28–31	Not sampled	Dark reddish-brown (5YR 3.5/4) sticky clay loam with some small pebbles; medium to coarse subangular blocky structure moderately coated with brown (7.5YR 4/2) clay material; a few roots.
C_1.......	31–34	17831	Reddish-brown (5YR 5/4) loam borderline to sandy loam till with numerous small pebbles; calcareous; a few roots.
C_2.......	34–41+	17832	Reddish-brown (5YR 4.5/3) loam to sandy loam till with small and medium pebbles; calcareous; some portions of this layer were of loam and silt loam texture but these heavier portions were not included in the sample.

Profile No. 6 — Miami silt loam (24)

Iroquois county, T27N, R11W, Sec. 21, SW¼, about center SW40. Pit for sampling dug near edge of broad ridge on convex slope of 5 percent to west. Parent material to a depth of 22 inches may be silty till or may be partly loess of late Peorian age on leached till 22 to 29 inches deep; below 29 inches is calcareous loam till of Iroquois morainic age of Cary substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated roadside along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

Horizon	Depth *(inches)*	Sample No.	
A_1.......	0–3	17731	Very dark grayish-brown (10YR 3/1.5) silt loam with a little fine sand; granular structure; numerous fine roots.
A_{21}......	3–7	17732	Yellowish-brown (10YR 5/4) silt loam with a little fine sand; thin platy structure; numerous fine roots; a few large roots; numerous worm burrows.
A_{22}......	7–10	17733	Yellowish-brown (10YR 5/4) grading downward to brown (10YR 5/3) silt loam with a little fine sand; fine subangular blocky structure; numerous fine roots; some worm burrows.
B_1.......	10–15	17734	Brown (10YR 5/3) with faint mottles of yellowish-brown (10YR 5/4) silty clay loam with some fine sand and a few pebbles; moderate medium subangular blocky structure with some thin coatings of light brownish-gray (10YR 6/2); some roots and worm burrows but less numerous than above.
B_2.......	15–18 18–22	17735 17736	Yellowish-brown (10YR 5/4) clay loam or silty clay loam with some sand and a few small pebbles; fine to medium nearly angular blocky structure with some thin coatings of light brownish-gray (10YR 6/2).
B_3.......	22–29	17737	Dark yellowish-brown (10YR 4/6) clay loam or silty clay loam with some sand and small pebbles; coarse to very coarse subangular blocky structure with some dark coatings of organic matter and dark grayish-brown (10YR 4/2) clay; few roots; occasional worm burrow.
C_1.......	29–34	17738	Light yellowish-brown (10YR 6/4) calcareous loam till; dark grayish-brown (10YR 4/2) organic-coated cleavage faces extend into this layer from above.
C_2.......	34+	17739	Light yellowish-brown (10YR 6/4) loam till; massive; calcareous.

Profile No. 7 — Miami silt loam, pink till variant (24)

McHenry county, T44N, R5E, Sec. 12, NE¼, NE40, NW10. Pit for sampling dug near crest of convex ridge on 7-percent slope to east. Silty-sandy surficial material to a depth of about 15 inches may be partially loess of late Peorian age mixed with sand of local origin. At a depth of 15 to 39 inches is leached till and below 39 inches is calcareous pinkish heavy loam till of Bloomington (Marengo) morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated second-growth woods.

Horizon	Depth *(inches)*	Sample No.	
A_1	0–3	17815	Very dark brown (10YR 2/2) silt loam with a little sand; many large and small roots.
A_{21}	3–5	17816	Brown (9YR 5/2.5) silt loam with some sand; some earthworm burrows filled with dark A_1 material; some large, some small, and a few fibrous roots.
A_{22}	5–10	17817	Grayish-brown to light brown (9YR 5.5/2.5) silt loam with some sand; a few medium roots.
B_1	10–15	17818	Brown (7.5YR 4.5/4) silty clay loam with a little sand; very fine subangular blocky structure; a few medium roots.
B_{21}	15–22	17819	Reddish-brown (5YR 3.5/4) silty clay loam borderline to silty clay with some sand and a few pebbles; fine subangular blocky structure with thin brown (7.5YR 5/4) coatings; a few medium roots.
B_{22}	22–28 28–34	17820 17821	Dark reddish-brown (5YR 3/4) sticky clay loam or silty clay loam with some sand and small pebbles; medium subangular blocky structure; few medium roots.
B_3	34–39	17822	Same as B_{22} but with small remnants of limestone pebbles.
C	39–54+	17823	Reddish-brown (5YR 4/4) loam till borderline to clay loam; calcareous.

Profile No. 8 — Blount silt loam (23)

Will county, T34N, R9E, Sec. 36, SE¼, SE40, SW10. Pit for sampling dug on broad convex ridge on 2-percent slope to northeast. Loess or silty overburden, if present, probably not more than 10 inches thick on leached till 10 to 25 inches deep. Below 25 inches is calcareous compact silty clay loam till of Rockdale morainic age of Cary substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated and probably virgin woodlot.

A_1	0–4	17495	Very dark gray to dark gray (10YR 3/1-4/1) crushing to very dark gray to very dark grayish-brown (10YR 3/1-3/2) friable silt loam; weak granular structure.
A_2	4–7	17496	Grayish-brown (10YR 4.5/2) crushing to dark grayish-brown (10YR 4/2) friable silt loam; thin platy structure.
A_3	7–10	17497	Brown (10YR 4.5/3) crushing to dark grayish-brown to brown (10YR 4/2-4/3) friable silt loam borderline to silty clay loam; medium to coarse granular structure with some gray (10YR 6/1) silty coatings.
B_1	10–14	17498	Brown (10YR 5/3) crushing to brown (10YR 4/3) firm silty clay loam; fine to medium subangular blocky structure with some light brownish-gray (10YR 6/2) coatings.
B_{21}	14–20	17499	70% light olive-brown (2.5Y 5/4) and 30% dark yellowish-brown (10YR 4/4) crushing to olive-brown (2.5Y 4.5/4) very firm to hard silty clay; medium to coarse blocky to weakly prismatic structure with some grayish-brown (10YR 5/2) silty coating and some dark grayish-brown (10YR 4/2) organic coatings.

Horizon	Depth *(inches)*	Sample No.	
B_{22}	20–25	17500	Light olive-brown (2.5Y 5/4) crushing to same color very firm to hard silty clay; medium to coarse blocky to weakly prismatic structure with some black (10YR 2/1) waxy organic coatings.
C	25–30 30–36 36–42+	17501 17502 17503	Light olive-brown (2.5Y 5.5/4) crushing to same color compact and hard calcareous silty clay loam; very coarse irregular blocky to massive structure with dark gray to dark grayish-brown (10YR 4/1-4/2) waxy organic coatings carrying down from, but less frequent than, B_2 and tending to disappear in lower part; some white (10YR 8/1) lime seams in lower part; some tree roots throughout A and B and into C horizon.

Profile No. 9 — Blount silt loam (23)

Will county, T34N, R14E, Sec. 24, SW¼, SE40, NW10. Pit for sampling dug on broad gently convex ridge on 2-percent slope to north. Probably little or no loess at this site though a different drift material seems to be present to a depth of 13 inches on leached till 13 to 25 inches deep. Below 25 inches is calcareous silty clay loam till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in pasture which was last cultivated about 20 years ago.

A_p	0–7	17520	Dark gray (10YR 4/1) crushing to grayish-brown (10YR 4.5/2) friable silt loam; fine to medium granular structure.
A_2	7–10	17521	50% pale brown (10YR 6/3) and 50% very pale brown (10YR 7/3) crushing to pale brown (10YR 6/3) friable silt loam; coarse granular to medium rounded subangular blocky structure.
B_1	10–13	17522	Light yellowish-brown (10YR 6/4) crushing to same color firm silty clay loam; fine to medium rounded subangular blocky structure with some pale brown (10YR 6/3) coatings.
B_{21}	13–19	17523	75% yellowish-brown (10YR 5/4) and 25% light brownish-gray (2.5Y 6/2) crushing to light yellowish-brown (10YR 5.5/4) very firm silty clay; medium to coarse blocky structure with some grayish-brown (10YR 6/2) clay coatings.
B_{22}	19–25	17524	40% yellowish-brown (10YR 5/4) and 60% light brownish-gray (2.5Y 6/2) crushing to pale brown (10YR 5.5/3) very firm silty clay; medium to coarse blocky to prismatic structure with some grayish-brown (10YR 6/2) clay coatings.
C_1	25–31	17525	75% light yellowish-brown (10YR 6/4) and 25% light gray (10YR 6/1) crushing to grayish-brown (2.5Y 5/2) very firm silty clay loam till; coarse blocky to prismatic structure with some light brownish-gray (10YR 6/2) clay coatings and some secondary lime coatings; calcareous.

Horizon	Depth (inches)	Sample No.	
C_2........	31–37	17526	75% light yellowish-brown (10YR 6/4) and 25%
	37–43+	17527	light gray (10YR 6/1) crushing to light olive-brown (2.5Y 5/3) very firm silty clay loam till; very coarse blocky to massive with some light gray (5Y 6/1) and some secondary lime coatings; calcareous.

Profile No. 10 — Eylar silt loam (228)

Will county, T35N, R12E, Sec. 19, NE¼, SE40, SE10. Pit for sampling dug on convex slope of 1 percent to north, east, and west. Probably loess of late Peorian age to a depth of 14 inches on leached till 14 to 26 inches deep. From 26 to 45 inches is calcareous silty clay till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated roadside sod along a concreted (formerly gravelled) road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_{11}......	0–3	17760	Very dark gray (10YR 3/1) crushing to very dark grayish-brown (10YR 3/2) friable silt loam; fine to medium crumb or granular structure; numerous fibrous roots.
A_{12}......	3–5	17761	75% dark gray (10YR 4/1) and 25% grayish-brown (10YR 5/2) friable silt loam; the light-colored (5/2) material has weak thin platy structure whereas the dark (4/1) material breaks into irregular crumb or granular structure; the darker material appears to have been worked into this layer from above by earthworms and insects.
A_2.......	5–9	17762	Pale brown (10YR 6/3) friable silt loam; moderately well-developed very fine platy structure in upper part to thin platy to very weak subangular blocky structure in lower part; many insect burrows filled with dark material from A_1 horizon.
B_1.......	9–14	17763	Pale brown (10YR 6/3) moderately plastic silty clay loam; fine angular blocky structure; occasional pebble; some roots; occasional worm burrow partially filled with material from A_1 horizon.
B_2.......	14–21	17764	75% yellowish-brown (10YR 5/4 to 1Y 5/4) and 25% brown (10YR 5/3 to 1Y 5/3) plastic silty clay; fine angular blocky structure; some small pebbles; some roots; very few earthworm burrows.
B_3.......	21–26	17765	Grayish-brown (2.5Y 5/2) with a few mottles of light olive-brown (2.5Y 5/6) and brownish-yellow (10YR 6/8) plastic silty clay; fine to medium angular blocky structure; occasional small pebble; very few roots; no worm burrows.
C_1.......	26–45	17766	Grayish-brown (2.5Y 5/2) with a few mottles of light olive-brown (2.5Y 5/4) and strong brown (7.5YR 5/8) silty clay till; medium to coarse angular blocky structure; calcareous; few small pebbles and an occasional secondary lime concretion; very few roots, which tend to follow cleavage faces.

Horizon	Depth *(inches)*	Sample No.	
C_2.......	45–50+	17767	Light yellowish-brown (10YR 6/4) mottled brownish-yellow (10YR 6/8) silty clay loam till; massive; calcareous; the material from this layer is too light-textured to be typical of the calcareous parent material of Eylar soils.

Profile No. 11 — Eylar silt loam (228)

LaSalle county, T33N, R4E, Sec. 13, NE¼, NE40, NE10. Pit for sampling dug on downslope from crest of ridge on 7-percent slope to south. Silty overburden, which may be loess of late Peorian age, to a depth of 9 inches on leached till 9 to 18 inches deep. Below 18 inches is plastic calcareous silty clay or clay till of Marseilles morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was oak-hickory forest. Sampled in uncultivated roadside sod along a formerly gravelled (presently blacktopped) road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_1.......	0–3	17754	Dark gray (10YR 4/1) silt loam; weak crumb to soft granular structure; numerous fibrous roots.
A_2.......	3–9	17755	50% brown (10YR 5/3) and 50% pale brown (10YR 6/3) friable silt loam; very weak platy to crumb structure; many fibrous roots; some root channels and worm burrows filled with dark A_1 material.
B_1.......	9–13	17756	50% dark yellowish-brown (10YR 4/4) and 50% brown (10YR 5/3) silty clay loam borderline to silty clay; very fine subangular blocky structure with clay films; some fibrous roots and root channels.
B_2.......	13–18	17757	50% brown (10YR 5/3) and 50% yellowish-brown (10YR 5/4) light silty clay with few yellowish-brown (10YR 5/6) mottles; fine angular blocky structure with dark gray (10YR 4/1) coatings or clay films; few roots and few worm burrows.
C_1.......	18–28	17758	75% grayish-brown (2.5Y 5/2) mottled with 15% light olive-brown (2.5Y 5/6) and 10% gray (5Y 5/1) silty clay till; fine angular blocky structure; calcareous; very occasional soft dark yellowish-brown (10YR 3/4) iron concretion; few roots; few small pebbles; no worm burrows observed.
C_2.......	28–50+	17759	90% light olive-gray (5Y 6/2) mottled with 5% light olive-brown (2.5Y 5/6) and 5% grayish-brown (2.5Y 5/2) clay or silty clay borderline to clay till; occasional strong brown (7.5YR 5/8) soft iron concretion and very pale brown (10YR 7/3) secondary lime accumulation; medium to coarse angular blocky structure; calcareous; few flattened roots which tend to follow structure faces; few pebbles; no worm burrows observed; within one rod of this sampling site depth to free carbonates varied from 18 to 24 inches.

Profile No. 12 — Beecher silt loam (298)

Will county, T34N, R9E, Sec. 36, SE¼, SE40, SW10. Pit for sampling dug on broad convex ridge on 2-percent slope to north. Loess or silty overburden, if present, probably not more than about 10 inches thick on leached till 10 to 31

inches deep. Below 31 inches is calcareous compact silty clay loam till of Rockdale morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was a recent encroachment of oak-hickory forest on bluestem prairie. Sampled in uncultivated and possibly virgin woodlot.

Horizon	Depth *(inches)*	Sample No.	
A_1.......	0–6	17485	Very dark gray (10YR 3.5/1) crushing to very dark grayish-brown (10YR 3/2) friable silt loam; fine granular structure.
A_2.......	6–9	17486	Dark gray to grayish-brown (10YR 4/1-5/2) crushing to dark grayish-brown (10YR 4.5/2) friable silt loam; medium granular structure.
A_3.......	9–13	17487	Grayish-brown (10YR 5/2) crushing to dark grayish-brown (10YR 4.5/2) firm silt loam; medium coarse to very coarse granular to medium subangular structure.
B_1.......	13–18	17488	Dark grayish-brown (1Y 4/2) crushing to same color hard silty clay loam; fine subangular blocky structure with some dark gray to dark grayish-brown (10YR 4/1-4/2) organic coatings along with some silty coatings; many worm burrows.
B_2.......	18–22 22–27	17489 17490	60% light olive-brown to light yellowish-brown (2.5Y 5/4-6/4), mottled 25% grayish-brown (2.5Y 5/2), and 15% yellowish-brown (10YR 5/6) crushing to dark grayish-brown (2.5Y 3.5/2) very firm to hard silty clay; medium to coarse blocky to weakly prismatic structure moderately coated black to very dark gray (10YR 2/1-3/1); many worm burrows.
B_3.......	27–31	17491	80% yellowish-brown (10YR 5/6) with 20% light brownish-gray (2.5Y 6/2) mottles, crushing to light olive-brown (2.5Y 5/4) hard silty clay; medium to coarse blocky to prismatic structure with thick waxy coatings of very dark gray to black (10YR 3/1-2/1); many worm burrows.
C.......	31–37 37–43 43–49+	17492 17493 17494	Light yellowish-brown (10YR 6/4) crushing to light olive-brown (2.5Y 5/4) compact and very hard calcareous silty clay loam till; very coarse irregular blocky to massive structure with light gray to white (10YR 7/1-8/1) streaks of secondary lime on some cleavage faces and root channels and with a few dark coatings which decrease with depth; some worm burrows and some tree roots extend into the unweathered till.

Profile No. 13 — Beecher silt loam (298)

Will county, T34N, R14E, Sec. 24, SW¼, SE40, NW10. Pit for sampling dug on broad convex ridge on 2-percent slope to north. Loess or silty overburden, if present, probably not more than about 10 inches thick on leached till 10 to 22 inches deep. Below 22 inches is calcareous compact silty clay loam till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was a recent encroachment of oak-hickory forest on bluestem prairie. Sampled in bluegrass pasture about 138 feet from gravelled road so that a little calcareous road dust may have affected pH and base saturation of the A

horizons. The pasture was last plowed about 20 years previous to sampling and the plowed layer was still visible.

Horizon	Depth *(inches)*	Sample No.	
A_p......	0–7	17512	Very dark gray (10YR 3/1) crushing to very dark grayish-brown (10YR 3/1.5) friable silt loam; fine to medium granular structure.
A_2.......	7–11	17513	Grayish-brown (10YR 5/2) crushing to grayish-brown (10YR 5/2) friable silt loam; medium to coarse granular structure.
B_1.......	11–14	17514	50% gray to grayish-brown (10YR 5/1-5/2) and 50% brownish-yellow (10YR 6/6) crushing to yellowish-brown (1Y 5/4) firm silty clay loam; fine to medium subangular blocky structure with some grayish-brown (10YR 5/2) silty coatings.
B_{21}......	14–18	17515	70% light yellowish-brown (10YR 6/4) and 25% light gray (10YR 7/2) with 5% brownish-yellow (10YR 6/6) mottles crushing to light olive-brown (2.5Y 4.5/4) very firm to hard silty clay; fine to medium blocky structure with some dark gray to very dark gray (10YR 4/1-3/1) waxy organic coatings.
B_{22}......	18–22	17516	70% light gray (5Y 7/2) and 30% light yellowish-brown (10YR 6/4) crushing to light yellowish-brown (2.5Y 5.5/4) very firm to hard silty clay; medium to coarse blocky to weakly prismatic structure with some dark gray to very dark gray (10YR 4/1-3/1) waxy coatings.
C_1	22–28	17517	70% light gray (5Y 7/1-7/2) and 30% light brownish-yellow (10YR 6/5) crushing to light yellowish-brown (2.5Y 5.5/4) very firm to hard calcareous heavy silty clay loam till; coarse blocky to medium prismatic structure with some dark gray to very dark gray (10YR 4/1-3/1) waxy coatings.
C_2	28–34 34–40+	17518 17519	60% light gray (5Y 6/1-7/1) and 40% light brownish-yellow (10YR 6/5) crushing to light yellowish-brown (2.5Y 6/4) hard calcareous silty clay loam till; irregular very coarse blocky to massive structure with a few dark gray (5Y 4/1) slightly waxy organic coatings.

Profile No. 14 — Frankfort silt loam to silty clay loam (320)

Will county, T35N, R12E, Sec. 29, SE¼, SW40, SW10. Pit for sampling dug on convex ridge on 3-percent slope to south. Probably little or no loess present. Leached till 0 to 22 inches deep on calcareous silty clay till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was a recent encroachment of oak-hickory forest on bluestem prairie. Sampled in sparse weedy vegetation along side of field entrance to paved road.

A_p.......	0–6	S51 Ill-99-1-1	Grayish-brown (10YR 5/2) crushing to same color silty clay loam; very weak fine subangular blocky to granular structure.
B_1.......	6–12	S51 Ill-99-1-2	Grayish-brown (10YR 5/2) mottled with pale brown (10YR 6/3) silty clay; fine to medium subangular blocky structure.

Horizon	Depth (inches)	Sample No.	
B_2.......	12–22	S51 Ill-99-1-3	Gray (10YR 5/1) crushing to pale brown (10YR 6/3) silty clay; strong medium angular blocky structure with some dark organic coatings.
C.......	22+	S51 Ill-99-1-4	Light gray (10YR 7/1) silty clay till; medium to coarse angular blocky structure; calcareous.

Profile No. 15 — Warsaw silt loam (290)

McHenry county, T46N, R7E, Sec. 16, NE¼, SW40, SE10. Pit for sampling dug on convex area on 2-percent slope to southeast. Parent material to a depth of 24 inches is silty overburden which may be loess of late Peorian age; between depths of 24 and 36 inches is leached till, and below 36 inches is calcareous loamy gravel to gravelly sand till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in uncultivated roadside along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_1.......	0–5 5–12	17603 17604	Very dark brown (10YR 2/2) silt loam; granular to crumb structure.
A_3.......	12–15	17605	Very dark grayish-brown (10YR 3/2) crushing to brown (10YR 4/2.5) silt loam; granular to weak subangular blocky structure.
B_1.......	15–19	17606	Dark grayish-brown (10YR 4/2) crushing to dark yellowish-brown (10YR 4/3.5) silty clay loam; very fine to fine weak subangular blocky structure.
B_{21}......	19–24	17607	Brown (7.5YR 4/3) crushing to strong brown (7.5YR 5/5) silty clay loam with a very few pebbles; fine weak subangular blocky structure.
B_{22}......	24–29	17608	Dark reddish-brown (5YR 3/5-3.5/4) crushing to strong brown (7.5YR 4/5) clay loam borderline to clay; fine to medium subangular blocky to blocky structure.
B_3.......	29–36	17609	Brown (7.5YR 4/5) crushing to strong brown (7.5YR 5/6) loam; weak coarse subangular blocky structure.
C_1.......	36–44	17610	Light brown (7.5YR 6/5) crushing to same color loose loamy gravel to loamy gravelly sand; calcareous till.
C_1.......	44–50+	17611	Same as sample 17610 except somewhat less rounded fine gravel.

Profile No. 16 — Warsaw silt loam (290)

McHenry county, T44N, R8E, Sec. 25, SW¼, SW40, SW10. Pit for sampling dug on crest of low convex ridge on 2-percent slope. Silty overburden, which may be loess or partly loess of late Peorian age, to a depth of 25 inches on leached till 25 to 29 inches deep. Below 29 inches is loose calcareous loamy gravel drift of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in uncultivated roadside sod along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

Horizon	Depth *(inches)*	Sample No.	
A_1.......	0–5 5–10	17612 17613	Very dark brown (10YR 2/2) crushing to very dark grayish-brown (10YR 3/2) silt loam; fine to medium crumb to granular structure.
A_3–B_1....	10–13	17614	Dark brown (10YR 3/3) crushing to dark yellowish-brown (10YR 4/4) silty clay loam; very fine to fine weak subangular blocky structure.
B_2.......	13–19 19–25	17615 17616	Dark brown (8YR 4/4) crushing to brown (7.5YR 5/5) silty clay loam; fine to medium weak subangular blocky structure; more sand in lower part.
B_3.......	25–29	17617	Dark brown (7.5YR 4/4) crushing to strong brown (7.5YR 5/6) sandy clay loam to loam.
C.......	29–40 40–50+	17618 17619	Loamy gravel (till?) of mixed composition including limestone.

Profile No. 17 — Ringwood silt loam (297)

McHenry county, T45N, R8E, Sec. 2, NW¼, NW40, NW10. Pit for sampling dug on convex area on 2-percent slope to east. Parent material to a depth of 17 inches is silty overburden, which may be loess of late Peorian age, at 17 to 34 inches deep is leached till, and below 34 inches is calcareous sandy loam till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Samples taken in uncultivated roadside along a gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_1.......	0–4 4–9	17595 17596	Very dark brown (10YR 2/2) silt loam with few sand grains; crumb structure.
A_3.......	9–11	17597	Very dark grayish-brown (10YR 3/2) silt loam with few sand grains; granular structure.
B_1.......	11–17	17598	Dark brown (7.5YR 4/2) crushing to brown (10YR 4/3) silty clay loam borderline to silt loam; fine subangular blocky structure with few gray flecks on faces.
B_2.......	17–25	17599	Brown (7.5YR 4/3-4/4) crushing to strong brown (7.5YR 4/5) clay loam to sandy clay loam; moderate subangular blocky to weak blocky structure.
B_{31}......	25–29	17600	Brown (7.5YR 4/3) crushing to strong brown (7.5YR 5/5) sandy clay loam; very weak subangular blocky structure.
B_{32}......	29–34	17601	Brown (7.5YR 5/4) crushing to strong brown (7.5YR 5/5) loam.
C.......	34–48+	17602	Light brown (7.5YR 6/4) crushing to reddish-yellow (7.5YR 6/5) very friable sandy loam till with pebbles; massive; calcareous.

Profile No. 18 — Ringwood silt loam (297)

McHenry county, T45N, R7E, Sec. 22, NE¼, NE40, SE10. Pit for sampling dug near edge of broad convex ridge on 2-percent slope to south. Silty overburden, which may be loess of late Peorian age, to a depth of about 13 inches on leached till 13 to 25 inches deep. Below 25 inches is calcareous sandy loam till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in uncultivated roadside sod along a

formerly gravelled (presently blacktopped) road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

Horizon	Depth (*inches*)	Sample No.	
A_1	0–4 4–8	17620 17621	Very dark brown (10YR 2/2) crushing to very dark grayish-brown (10YR 3/2) silt loam; granular structure.
A_3	8–10	17622	Very dark grayish-brown (10YR 3/2) crushing to dark grayish-brown (10YR 3.5/2) silt loam; granular structure.
B_1	10–13	17623	Dark brown (10YR 4/3) crushing to yellowish-brown (10YR 5/6) silty clay loam borderline to silt loam; fine subangular blocky structure.
B_2	13–17 17–20	17624 17625	Dark yellowish-brown (9YR 4.5/4) crushing to yellowish-brown (10YR 5/6) clay loam; fine to medium subangular blocky structure.
B_3	20–25	17626	Dark yellowish-brown (10YR 4/4) crushing to yellowish-brown (10YR 5/7) sandy loam; mostly massive but breaking into weak medium irregularly subangular blocky fragments.
C	25–36 36–48+	17627 17628	Light yellowish-brown (10YR 6/4) sandy loam till with pebbles; massive; calcareous.

Profile No. 19 — Saybrook silt loam (145)

McLean county, T24N, R5E, Sec. 11, SW¼, SW40, NW10. Pit for sampling dug on convex area on slope of 1-percent to south. Loess of Peorian age to a depth of 28 inches on leached till 28 to 35 inches deep on calcareous silt loam till of Outer Cropsey morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was big bluestem prairie. Sampled in uncultivated roadside along a gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_1	0–11	17775	Black to very dark brown (10YR 2/1-2/2) silt loam; fine to medium crumb to granular structure.
A_3	11–17	17776	Very dark gray (10YR 3/1) silt loam borderline to silty clay loam; medium granular to crumb structure.
B_1	17–21	17777	Dark grayish-brown to brown (10YR 4/2-4/3) silty clay loam borderline to silt loam; medium to fine granular structure moderately coated dark gray to very dark gray (10YR 4/1-3/1).
B_2	21–28	17778	Brown (10YR 5/3), 15% mottled yellowish-brown (10YR 5/8), silty clay loam; fine subangular blocky structure moderately coated, mostly along worm burrows, dark gray to very dark gray (10YR 4/1-3/1).
B_3	28–35	17779	Yellowish-brown (10YR 5/4) to light yellowish-brown (10YR 6/4) mottled 15% yellowish-brown (10YR 5/8) and 10% brownish-yellow (10YR 6/6) clay loam or gritty silty clay loam; weak medium to coarse subangular blocky structure, thinly coated dark gray (10YR 4/1).

Horizon	Depth *(inches)*	Sample No.	
C.......	35–50+	17780	Olive-brown (2.5Y 4.5/4) mottled 15% light brownish-gray (2.5Y 6/2) and 10% yellowish-brown (10YR 5/8) silt loam till; massive to very weak coarse blocky; some dark gray (10YR 4/1) krotovinas.

Profile No. 20 — Saybrook silt loam (145)

Will county, T37N, R9E, Sec. 18, NW¼, SE40, SE10. Pit for sampling dug on convex ridge on 4-percent slope to north. Probably little or no loess present. Leached till 0 to 30 inches deep on calcareous loam till of Minooka morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in uncultivated bluegrass sod along a paved (formerly gravelled) road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizon.

A_1.......	0–14	48 Ill-99-4-1	Very dark brown (10YR 2/2) friable silt loam; granular structure.
A–B.....	14–19	48 Ill-99-4-2	Dark brown (10YR 4/3) and very dark gray (10YR 3/1) silty clay loam borderline to silt loam; fine crumb to soft fine granular structure.
B_2.......	19–30	48 Ill-99-4-3	Very dark grayish-brown (10YR 3/2) crushing to yellowish-brown (10YR 5/6) silty clay loam; very fine to fine subangular blocky structure with some dark coatings.
C.......	30+	48 Ill-99-4-4	Yellowish-brown (10YR 5/4-5/6) friable calcareous loam till.

Profile No. 21 — Elliott silt loam (146)

Will county, T33N, R9E, Sec. 1, NE¼, NE40, NW10. Pit for sampling dug on low broad convex ridge on 2-percent slope to southeast. Loess or silty overburden, if present, probably not more than about 10 inches thick on leached till 10 to 29 inches deep. Below 29 inches is calcareous silty clay loam till of Rockdale morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in uncultivated and possibly virgin sod from an abandoned farm lot.

A_1.......	0–5 5–10	17476 17477	Very dark gray (10YR 3/1) crushing to same color friable silt loam; fine granular structure.
A_3.......	10–14	17478	Dark grayish-brown (2.5Y 3.5/2) crushing to very dark grayish-brown (2.5Y 3/2) friable to slightly firm silt loam borderline to silty clay loam; fine subangular blocky structure with coatings of very dark gray (10YR 3/1).
B_2.......	14–19 19–24	17479 17480	Olive-brown (2.5Y 4/3-4/4) crushing to olive-brown (2.5Y 4/3) firm silty clay; fine to medium subangular blocky structure with some slightly waxy very dark grayish-brown coatings; earthworm burrows.
B_3.......	24–29	17481	50% yellowish-brown (10YR 5/6) and 50% light olive-brown (2.5Y 5/4) crushing to dark grayish-brown (2.5Y 4/2) very firm to hard silty clay loam; medium to coarse prismatic structure with thick waxy very dark gray to black (10YR 3/1-2/1) coatings; earthworm burrows.

Horizon	Depth (*inches*)	Sample No.	
C........	29–35 35–41 41–48+	17482 17483 17484	70% light olive-brown (2.5Y 5/4) and 30% light olive-brown grading to light gray (2.5Y 5/4 to 6/2-7/2) crushing to light olive-brown (2.5Y 5/4) hard calcareous silty clay loam till; coarse irregular blocky to weakly prismatic structure with an occasional very dark gray to black (10YR 3/1-2/1) coating; some earthworm burrows into the C horizon.

Profile No. 22 — Elliott silt loam (146)

Will county, T34N, R14E, Sec. 24, SW¼, SE40, NW10. Pit for sampling dug on broad convex ridge on 2-percent slope to north. Loess or silty overburden, if present, probably not more than about 10 inches thick on leached till 10 to 24 inches deep. Below 24 inches is calcareous compact silty clay loam till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in bluegrass pasture about 28 feet from gravelled road so that some calcareous road dust may have affected pH and base saturation of the A horizons. Pasture last plowed about 20 years previous to sampling but plowed layer not visible.

A_{11}......	0–7	17504	Black (10YR 2/1) crushing to very dark gray (10YR 3/1) friable silt loam; fine to medium granular structure.
A_{12}......	7–12	17505	Black (10YR 2/1) crushing to very dark gray (10YR 3/1) firm silt loam; fine to medium granular structure slightly more angular than A_{11}.
B_1.......	12–16	17506	70% brown (10YR 5/3) and 30% dark grayish-brown (2.5Y 4/2) crushing to dark grayish-brown (2.5Y 4/2) hard silty clay loam; fine to medium blocky structure with some dark gray to very dark gray (10YR 4/1-3/1) waxy organic coatings.
B_{21}......	16–21	17507	90% light olive-brown (2.5Y 5/4-5/6), 10% mottled grayish-brown (2.5Y 5/2), crushing to light olive-brown (2.5Y 5/4) hard silty clay; fine to medium blocky to weakly prismatic structure with some dark gray to very dark gray (10YR 4/1-3/1) waxy organic coatings.
B_{22}......	21–24	17508	50% light olive-brown (2.5Y 5/4) and 50% light gray (2.5Y 6/1) crushing to light yellowish-brown (2.5Y 5.5/4) hard silty clay loam borderline to silty clay; medium to coarse blocky to weakly prismatic structure with some dark gray to very dark gray (10YR 4/1–3/1) waxy organic coatings.
C.......	24–31	17509	60% light gray (5Y 7/2) and 40% brownish-yellow (10YR 6/6) crushing to light yellowish-brown (2.5Y 5.5/4) very firm calcareous silty clay loam till; coarse to very coarse irregular blocky structure with some grayish-brown (2.5Y 5/2) slightly waxy coatings.
C.......	31–38 38–43+	17510 17511	60% light yellowish-brown (10YR 6/4) and 40% light gray (5Y 6/1) crushing to light olive-brown (2.5Y 5/4) very firm calcareous silty clay loam till; irregular blocky to massive structure with some white (5Y 8/1) secondary lime coatings.

Profile No. 23 — Elliott silt loam (146)

Will county, T33N, R12E, Sec. 24, SE¼, SW40, SE10. Pit for sampling dug on narrow convex ridge on 2-percent slope to east, south, and west. Probably little or no loess present. Leached till 0 to 36 inches deep on calcareous silty clay loam till of Manhattan morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in bluegrass sod along blacktop (formerly gravelled) road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizon.

Horizon	Depth *(inches)*	Sample No.	
A_1	0–12	48 Ill-99-1-1	Very dark gray (10YR 3/1) friable silt loam; granular structure; numerous fibrous roots.
A–B	12–18	48 Ill-99-1-2	Dark grayish-brown (10YR 4/2) friable silt loam; granular structure; numerous fibrous roots.
B_{21}	18–24	48 Ill-99-1-3	Brown (7.5YR 5/2) to strong brown (7.5YR 5/6) crushing to brown (7.5YR 5/4) silty clay loam; fine to medium subangular blocky structure with some organic coatings.
B_{22}	24–36	48 Ill-99-1-4	Dark gray (10YR 4/1) and yellowish-brown (10YR 5/4) crushing to yellowish-brown (10YR 5/4) silty clay loam; medium angular blocky structure.
C.......	36+	48 Ill-99-1-5	Yellowish-brown (10YR 5/6) and dark gray (10YR 4/1) calcareous silty clay loam till; coarse angular blocky to massive structure.

NOTE: Color of B horizon indicates this profile correlates with Varna more closely than with Elliott (see key to soil series, in pocket inside back cover).

Profile No. 24 — Swygert silt loam (91)

Ford county, T26N, R9E, Sec. 19, NE¼, NW40, NW10. Pit for sampling dug on 5-percent slope to north slightly below crest of convex knoll. Silty material to a depth of 14 inches, probably loess of Peorian age, on leached till 14 to 27 inches deep. Below 27 inches is calcareous silty clay and silty clay loam till of Chatsworth morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in uncultivated roadside sod along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_{11}	0–8	17790	Black to very dark brown (10YR 2/1.5) silt loam borderline to silty clay loam; fine crumb to granular structure.
A_{12}	8–11	17791	Black to very dark gray (10YR 2.5/1) silt loam borderline to silty clay loam; fine crumb to granular structure.
B_1	11–14	17792	Very dark gray (10YR 3/1) silty clay loam borderline to silt loam with an occasional small pebble; very fine to fine subangular blocky structure.
B_{21}	14–18	17793	Light olive-brown (2.5Y 5/3) silty clay loam borderline to silty clay with an occasional small pebble; very fine to fine angular blocky structure thinly organic-coated dark grayish-brown (2.5Y 4/2).

Horizon	Depth (*inches*)	Sample No.	
B_{22}......	18–23	17794	Olive-brown (2.5Y 4.5/3) silty clay borderline to silty clay loam with an occasional pebble; fine to medium angular blocky structure with moderate dark gray (10YR 4/1) organic coatings.
B_{23}......	23–27	17795	50% olive-brown (2.5Y 4.5/3) and 50% olive-gray (5Y 5/2) silty clay; medium prismatic structure moderately coated dark gray (10YR 4/1).
C_1.......	27–31	17796	50% olive-brown (2.5Y 4.5/3) and 50% olive-gray (5Y 5/2) silty clay loam to silty clay till; coarse prismatic structure partially coated dark gray (10YR 4/1); calcareous.
C_2.......	31–40+	17797	Same as C_1 except structure less pronounced and no dark coatings; this material is somewhat lighter-textured than is typical for unweathered parent till of Swygert soils.

Profile No. 25 — Swygert silt loam (91)

Will county, T34N, R12E, Sec. 12, NE¼, SE40, SE10. Pit for sampling dug on broad convex ridge on 2-percent slope. Probably no loess present. Leached till 0 to 26 inches deep on calcareous silty clay till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in bluegrass sod along gravelled road so that calcareous road dust may have affected pH and base saturation of the A horizon.

A_1.......	0–9	48 Ill-99-3-1	Very dark gray (10YR 3/1) friable silt loam; granular structure; numerous fibrous roots.
A–B.....	9–12	48 Ill-99-3-2	Dark grayish-brown (10YR 4/2) friable silt loam; numerous fibrous roots.
B_2.......	12–26	48 Ill-99-3-3	Light brownish-gray (10YR 6/2) mottled pale brown (10YR 6/3) silty clay; fine to medium subangular blocky structure; some fibrous roots mostly follow structure faces.
C.......	26+	48 Ill-99-3-4	Light brownish-gray (10YR 6/2) mottled light yellowish-brown (10YR 6/4) crushing to yellowish-brown (10YR 5/4) calcareous silty clay till; massive; few roots.

Profile No. 26 — Clarence silt loam to silty clay loam (147)

Livingston county, T30N, R5E, Sec. 29, SE¼, NE40, NE10. Pit for sampling dug on convex slope of 2 percent to south and southwest. Loess or silty overburden, if present, probably not more than 7 or 8 inches thick on leached till 8 to 15 inches deep. Below 15 inches is calcareous clay till of Chatsworth morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was bluestem prairie. Sampled in uncultivated roadside sod along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

A_1.......	0–5	17740	Very dark gray (10YR 3/1) silty clay loam borderline to silt loam; fine to medium granular to crumb structure; many fibrous roots; some worm burrows.

Horizon	Depth (*inches*)	Sample No.	
A_3.......	5–8	17741	Very dark gray and dark grayish-brown (10YR 4/1 and 4/2) silty clay loam borderline to silt loam; fine to medium granular structure; some fibrous roots; some earthworm burrows with a few filled with dark A_1 material.
B_{21}......	8–11	17742	Brown and yellowish-brown (10YR 5/3 and 5/4) plastic silty clay with a few very dark gray (10YR 3/1) spots or mottles; very fine angular blocky structure with clay coatings; few roots and worm burrows with an occasional channel filled with dark A_1 material.
B_{22}......	11–15	17743	80% brown (10YR 5/3) mottled 10% yellowish-brown (10YR 5/4) and 10% dark gray (10YR 4/1) plastic clay; very fine angular blocky structure with dark gray (10YR 4/1) organic clay coatings; few roots and those tend to follow aggregate faces.
C_1.......	15–24	17744	Grayish-brown (2.5Y 5/2) clay till; fine to medium angular blocky structure with light olive-brown (2.5Y 5/4) coatings; calcareous; very few roots, most of which follow aggregate faces and are flattened.
C_2.......	24–50+	17745	Same as C_1 except coarse to very coarse angular blocky structure and occasional secondary lime concretions and fragments or pebbles of shale and limestone. The depth to carbonates within 2 rods of this sampling site varied from 15 to 22 inches.

Profile No. 27 — Clarence silt loam to silty clay loam (147)

Will county, T34N, R12E, Sec. 2, SW¼, SE40, SW10. Pit for sampling dug on broad convex ridge on 2-percent slope to west. Probably no loess present. Leached till 0 to 29 inches deep on calcareous compact clay till of Valparaiso morainic age of Cary substage of Wisconsin glaciation. Native vegetation was probably bluestem prairie. Sampled in bluegrass sod, along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizon.

A_1.......	0–11	48 Ill-99-5-1	Very dark gray to dark gray (10YR 3/1-4/1) friable silt loam; granular structure.
A–B.....	11–16	48 Ill-99-5-2	Dark gray (10YR 4/1) and dark grayish-brown (10YR 4/2) mottled dark yellowish-brown (10YR 4/4) silty clay loam; very fine to fine subangular blocky structure with some dark gray (10YR 4/1) coatings.
B_2.......	16–29	48 Ill-99-5-3	Gray (10YR 5/1) mottled brown (10YR 5/3) silty clay; medium angular blocky structure with gray (10YR 5/1) coatings.
C.......	29+	48 Ill-99-5-4	Light gray (10YR 7/1) mottled pale brown (10YR 6/3) crushing to light brownish-gray (10YR 6/2) silty clay to clay till; medium angular blocky structure.

Profile No. 28 — Drummer silty clay loam (152)

Iroquois county, T26N, R11W, Sec. 15, NW¼, NW40, W10. Pit for sampling dug in concave area on slope of about ½ percent. Parent material to a depth of 60 inches is mostly water-deposited, probably including local slope wash, and below a depth of 60 inches it is calcareous loam till of Iroquois morainic age of Cary substage of Wisconsin glaciation. Native vegetation was slough grass and other wet-prairie plants. Samples were taken from uncultivated roadside sod along a gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

Horizon	Depth (*inches*)	Sample No.	
A_1	0–2	16543	Black (10YR 2/1) silty clay loam borderline to silt loam; well-developed fine crumb to soft fine granular structure.
	2–4	16544	
	4–6	16545	
	6–8	16546	
	8–10	16547	
A_3–B_1	10–12	16548	Very dark gray (10YR 3/1) silty clay loam borderline to silt loam; weak medium granular to very fine subangular blocky structure.
B_{21}	12–15	16549	Dark gray (1Y 3.5/1) silty clay loam; moderate fine subangular blocky structure.
B_{22}	15–18	16550	Gray (1Y 4.5/1) silty clay loam with few fine faint yellowish-brown (10YR 5/4) mottles; moderate fine subangular blocky structure.
	18–21	16551	
	21–24	16552	
	24–27	16553	
B_3	27–30	16554	Mixed grayish-brown (1Y 5/2) and yellowish-brown (1Y 5/4) clay loam with few dark yellowish-brown (10YR 4/4) mottles; medium to coarse subangular blocky in upper part and very coarse subangular blocky to massive in lower part.
	30–34	16555	
C_1	34–38	16556	Mixed grayish-brown (1Y 5/2), yellowish-brown (1Y 5/4), and dark yellowish-brown (10YR 4/4) calcareous stratified fine sand, fine sandy loam, silt loam, and clay loam.
	38–43	16557	
	43–50	16559[1]	
C_2	50–60	16560	Sandy loam, stratified.
D	60+	Not sampled	Mixed dark grayish-brown (10YR 4/2) and dark yellowish-brown (10YR 4/4) compact calcareous loam till.

NOTE: Description of this profile was written a few feet north of sampling site.

Profile No. 29 — Drummer silty clay loam (152)

McLean county, T24N, R5E, Sec. 11, SW¼, SW40, SW10. Pit for sampling dug in concave area on slope of ½ percent or less. Parent material to a depth of 50 inches is mixed local slope wash and loess of Peorian age; from 50 to 60 inches deep it is water-deposited material; and below 60 inches it is calcareous loam till of Outer Cropsey morainic age of the Tazewell substage of Wisconsin glaciation. Native vegetation was slough grass together with other wet-prairie plants. Samples were taken from uncultivated roadside along a gravelled road so

[1] Analyses of Sample 16558, taken from the plow layer of an adjacent field, are not included.

that calcareous road dust may have affected pH and base saturation, particularly of the A horizons.

Horizon	Depth *(inches)*	Sample No.	
A_{11}	0–9	17781	Black (10YR 2/1) silty clay loam; well-developed fine to medium granular structure.
A_{12}	9–16	17782	Black (10YR 2/1) silty clay loam; well-developed medium granular to weak very fine subangular blocky structure.
B_1	16–21	17783	Very dark gray to dark gray (2.5Y 3/1-4/1) silty clay loam; well-developed very fine subangular blocky structure.
B_{21}	21–25	17784	Dark gray to dark grayish-brown (2.5Y 4/1-4/2), 10% mottled with very small spots of yellowish-brown (10YR 5/6), silty clay loam; well-developed fine subangular blocky structure with prominent dark coatings.
B_{22}	25–29	17785	75% dark gray to dark grayish-brown (2.5Y 4/1 to 4/2) and 25% mottled yellowish-brown (10YR 5/6) silty clay loam; well-developed fine blocky structure with organic coatings; slightly more clay than B_{21}.
B_3	29–35	17786	70% dark grayish-brown (2.5Y 4/2) and 30% mottled yellowish-brown (10YR 5/6) silty clay loam borderline to silt loam; medium to coarse blocky structure with faint dark gray (2.5Y 4/1) organic coatings.
C_1	35–50	17787	55% gray (2.5Y 6/1) and 35% yellowish-brown (10YR 5/8), with 10% black (2.5Y 2/1) filling in crayfish burrows, silty clay loam borderline to silt loam; massive; scattering of sand grains.
C_{21}	50–54	17788	Mixed gray and yellowish-brown (10YR 5/1 and 5/6) fine gravelly loam; stratified.
C_{22}	54–60	Not sampled	Mixed light olive-brown and light gray (2.5Y 5/5 and 7/1) silt loam borderline to silty clay loam.
D	60–65+	17789	Mixed light olive-brown to light yellowish-brown and light gray (2.5Y 5/4-6/4 and 6/1-7/1) loam till, mottled yellowish-red, light reddish-brown, pale yellow, and yellow (5YR 5/6 and 6/4, 2.5Y 8/3 and 8/6); calcareous.

Note: Krotovinas (crayfish burrows filled with dark A horizon material) are present throughout the B and C horizons although noted in only one sampling layer.

Profile No. 30 — Ashkum silty clay loam (232)

Iroquois county, T24N, R12W, Sec. 11, NW¼, NW40, N10. Pit for sampling dug in concave area on slope of ½ percent to north. Parent material to a depth of 24 inches is mostly local slope wash; between depths of 24 and 27 inches it is partially leached till but with few small secondary lime concretions; below 27 inches it is calcareous silty clay loam till of Chatsworth morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was slough grass and other wet-prairie plants. Samples were taken from uncultivated roadside sod along oiled road.

Horizon	Depth (*inches*)	Sample No.	
A_1.......	0–2 2–4 4–6 6–8 8–10	16490 16491 16492 16493 16494	Black (10YR 1.5/1) silty clay loam; moderate medium granular to very fine subangular blocky structure; full of fibrous roots.
A_3–B_1....	10–12 12–15	16495 16496	Black (10YR 2/1), mixed with very dark gray (2.5Y 3/1) and dark grayish-brown (2.5Y 4/2) mottles, silty clay loam; moderate very fine subangular blocky structure; some fibrous roots; earthworm burrows; an occasional pebble.
B_{21}......	15–18	16497	Mixed very dark gray (10YR 3/1-3/0) and dark grayish-brown (2.5Y 4/2) mottled light olive-brown (2.5Y 5/4) silty clay loam; very fine and fine subangular blocky structure; some earthworm burrows; few pebbles.
B_{22}......	18–21 21–24	16498 16499	Dark grayish-brown (2.5Y 4/2 and 4/3) mottled light olive-brown (2.5Y 5/4) silty clay loam; fine subangular blocky structure with some thin organic coatings; some pebbles and small stones; a few earthworm burrows.
B_3.......	24–27	16500	60% dark grayish-brown (2.5Y 4/2) and 40% light olive-brown (2.5Y 5/4) mottled dark yellowish-brown (10YR 4/4) silty clay loam; fine and medium subangular blocky structure; some small secondary lime concretions; some pebbles and small stones.
C.......	27–30 30–34 34–38 38–44 44–50 50–58+	16501 16502 16503 16504 16505 16506	Mixed dark gray (5Y 4/1) and olive-brown (2.5Y 4/4) silty clay loam calcareous till; very coarse angular blocky to massive; some pebbles and stones; a few earthworm burrows extend to a depth of about 40 inches and a few krotovinas to about 50 inches.

Profile No. 31 — Bryce silty clay (235)

Iroquois county, T24N, R13W, Sec. 19, SW¼, SW40, SW10. Pit for sampling dug in nearly level area on slope of less than ½ percent. Parent material to a depth of 34 inches may be mostly water-deposited lakebed sediment but including some local slope wash. From 34 to 44 inches deep it is weakly calcareous till and below 44 inches it is calcareous silty clay till of Chatsworth (?) morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was slough grass and associated wet-prairie plants. Samples were taken from uncultivated roadside along oiled road.

A_1.......	0–2 2–4 4–6 6–8 8–10 10–12	16473 16474 16475 16476 16477 16478	Black (10YR 1.5/1) crushing to black (10YR 2/1) silty clay loam to silty clay; very fine subangular blocky structure; many fibrous roots.
B_1.......	12–15	16479	Black (10YR 2/1), with few fine faint brown (10YR 5/3) mottles, silty clay; moderate very fine and fine subangular blocky structure.

Horizon	Depth (*inches*)	Sample No.	
B_{21}......	15–18 18–21	16480 16481	Very dark gray (10YR 3/1 to 3/0) mottled light olive-brown (2.5Y 5/3) silty clay; moderate fine to medium subangular blocky to angular blocky structure.
B_{22}......	21–24	16482	Mixed dark gray (10YR 4/1) and light olive-brown (2.5Y 5/4), with few fine dark yellowish-brown (10YR 4/4) mottles, silty clay; moderate fine to medium subangular blocky structure.
B_{23}......	24–27 27–30	16483 16484	Mixed dark grayish-brown (2.5Y 4/2) and light olive-brown (2.5Y 5/4), with some small dark yellowish-brown (10YR 4/4) mottles, silty clay; moderate medium subangular blocky structure with thin discontinuous dark gray (10YR 4/1) coatings.
B_3.......	30–34	16485	Olive-gray (5Y 5/2) with streaks of light olive-brown (2.5Y 5/4) and mottles of dark yellowish-brown (10YR 4/4) silty clay; moderate medium subangular blocky structure.
C_1.......	34–38 38–44	16486 16487	Gray (5Y 5/1) and olive-gray (5Y 5/2) mottled yellowish-brown (10YR 5/6) silty clay till; weakly calcareous; medium to coarse subangular to angular blocky to massive.
C_2.......	44–54 54–58+	16488 16489	Gray (5Y 5/1) mottled dark yellowish-brown (10YR 4.5/4) calcareous silty clay till; massive; few pebbles and small stones; occasional krotovina extending to depth of 60 inches.

Profile No. 32 — Bryce silty clay (235)

Iroquois county, T25N, R13W, Sec. 4, along east line 29 rods south of road through middle of section. Pit for sampling dug in concave area on slope of ½ percent to east. Parent material to a depth of 18 inches is probably lakebed sediment. Between 18 inches and 21 inches deep it is very weakly calcareous and may be till. Below 21 inches it is calcareous silty clay till of Chatsworth (?) morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was slough grass and other wet-prairie plants. Samples were taken from uncultivated roadside sod along gravelled road so that calcareous road dust may have affected pH and base saturation, particularly of the A horizon.

A_1.......	0–2 2–4 4–6 6–8 8–10	16525 16526 16527 16528 16529	Black (10YR 1/1) crushing to black (10YR 2/1) silty clay; very fine subangular blocky structure; many fibrous roots.
A_3.......	10–12	16530	Black (2.5Y 2/1) to very dark gray (2.5Y 3/0) with few fine faint mottles of light olive-brown (2.5Y 5/4) silty clay; moderate very fine and fine subangular blocky structure.
B_{21}......	12–15	16531	Black (2.5Y 2.5/0) mottled olive-brown (2.5Y 4/4) silty clay; moderate fine subangular to angular blocky structure.
B_{22}......	15–18	16532	Dark gray (2.5Y 4/1.5) and light olive-brown (2.5Y 5/4) with fine mottles of dark yellowish-brown (10YR 4/4) silty clay; fine subangular to angular blocky structure.

Horizon	Depth *(inches)*	Sample No.	
B_3.......	18–21	16533	Dark gray (5Y 4.5/1) specked dark yellowish-brown (10YR 4/4) silty clay till; fine subangular to angular blocky structure; weakly calcareous with some secondary lime concretions.
C.......	21–24	16534	Mixed gray (5Y 5/1) and dark yellowish-brown (10YR 4/4) silty clay till; fine to medium angular blocky in upper part to massive in lower; calcareous; krotovinas of very dark gray (2.5Y 3/0) extend into C with a few to a depth of 60 inches.
	24–27	16535	
	27–30	16536	
	30–34	16537	
	34–38	16538	
	38–44	16539	
	44–53	16540	
	53–60+	16541	

Profile No. 33 — Rowe silty clay loam to silty clay (230)

Iroquois county, T24N, R14W, Sec. 33, NE¼, NE40, NE10. Pit for sampling dug in concave area on slope of ½ percent to southeast. Parent material to a depth of 38 inches is probably leached till and/or mixed local slope wash. Below 38 inches is calcareous clay till of Chatsworth morainic age of Tazewell substage of Wisconsin glaciation. Native vegetation was slough grass and other wet-prairie plants. Samples taken from uncultivated roadside sod along oiled road.

A_1.......	0–2	16455	Black (10YR 2/1) crushing to very dark brown (10YR 2/2) silty clay loam; weak medium granular to very fine subangular blocky structure.
	2–4	16456	
	4–6	16457	
	6–8	16458	
A_3.......	8–10	16459	Dark gray (10YR 4/1) mottled light olive-brown (2.5Y 5/4) silty clay loam; very fine subangular blocky structure.
B_1.......	10–12	16460	Very dark gray (10YR 3/1) mottled dark yellowish-brown (10YR 4/4) silty clay loam borderline to silty clay; fine subangular to angular blocky structure.
B_{21}......	12–15	16461	Dark gray (10YR 4/1) mottled yellowish-brown (10YR 5/4) silty clay; medium subangular to angular blocky structure with thin discontinuous black (10YR 2/1) clay coatings; some soft iron-manganese concretions.
	15–18	16462	
B_{22}......	18–21	16463	Dark gray (10YR 4/1) and gray (10YR 5/1) mottled dark yellowish-brown (10YR 4/4) silty clay; moderate medium angular blocky structure with some thin dark gray (10YR 4/1) clay coatings.
	21–24	16464	
	24–27	16465	
	27–30	16466	
B_3.......	30–34	16467	Mixed dark gray (2.5Y 4/1), dark grayish-brown (2.5Y 4/2), and olive-brown (2.5Y 4/4) silty clay; fine and medium angular blocky structure.
	34–38	16468	
C_1.......	38–44	16469	Gray (2.5Y 5/0-5/1) and olive-brown (2.5Y 4/4) silty clay borderline to clay till; fine angular blocky in upper part to massive in lower part; weakly calcareous in lower part; iron-manganese concretions.
C_2.......	44–53	16470	Mixed gray (2.5Y 5/1) and light olive-brown (2.5Y 5/4) silty clay borderline to clay till; massive calcareous; occasional pebble; occasional krotovina to a depth of 50 inches.
	53–57+	16471	

APPENDIX B: ANALYTICAL PROCEDURES

Hydraulic conductivity and capillary and noncapillary pore space

The samples for hydraulic conductivity and capillary and noncapillary pore space were taken in 3-inch metal cylinders and analyzed by the methods described by Van Doren and Klingebiel (1949). On a few samples hydraulic conductivity was determined with the constant-head conductivity rack described by Uhland and O'Neal (1951). One-third-atmosphere moisture (field capacity) and 15-atmosphere moisture (wilting coefficient) determinations were made as outlined by Richards (1954).

Particle-size distribution

Particle-size distribution was determined in this laboratory according to the pipette method as described by Gieseking (1949). Because this method destroys particles of limestone and dolomite, additional determinations were made on calcareous samples by the procedure described by Kilmer and Alexander (1949) except that Calgon (a hexametaphosphate preparation) was used as a dispersing agent with 24-hour end-over-end shaking. Also the coarse silt fraction (20μ–50μ) was determined by sedimentation rather than obtained by difference as in the procedure of Kilmer and Alexander. Therefore the totals of the sand, silt, and clay fractions may not add up to 100 percent. The fine clay fraction ($<0.2\mu$) was determined using the No. 2 International centrifuge.

Total carbon

Total carbon was determined by the dry-combustion method on some samples of profiles numbered 28, 30, 31, 32, and 33. This method was outlined by Winters and Smith (1929). In this method a 2-gm. finely ground soil sample mixed with 0.25 gm. of manganese dioxide is pushed into a heated quartz tube surrounded by an electric furnace and kept at a temperature of approximately 950° C. for a period of 10 minutes. The evolved CO_2 is adsorbed on ascarite and weighed. Anhydrone is used to remove water vapor from the train.

Organic carbon

Organic carbon was determined primarily by the wet-combustion method and the chromic-acid-reduction method described by Allison (1935). In the latter method a 0.5-gm. <100-mesh sample of soil is mixed with 0.1961 gm. potassium dichromate to which 10 ml. of concentrated sulphuric acid is added. The mixture is stirred constantly as it is heated to 175° C. over a low flame in about 90 seconds. After cooling, the excess chromic acid is back-titrated with 0.2N ferrous ammonium sulphate using ortho-phenanthroline as the indicator. The percent of organic carbon is then calculated by multiplying the milliliters of ferrous ammonium sulphate used by 0.138. A hot oil bath was substituted for an open flame in the procedure described above.

A few of the organic-carbon determinations were made using an induction carbon apparatus. An alundum boat is lined about ⅓ full with granular alundum. On this is placed 0.2727 gm. (if over 2-percent carbon) of soil mixed with 2 gm. of carbon-free electrolytic iron. The sample is

covered with additional alundum, and heated by the induction effects in the iron. The CO_2 is collected in "Caroxite" and weighed. Each 10 mgm. of weight increase equals 1 percent of carbon for a sample weighing 0.2727 gm.

Clay mineralogy

The $<2\ \mu$ clay fraction was separated from the total soil suspension by decanting to the proper depth at the proper time according to Stokes' law. Four or five decantations were made which removed nearly all the material of clay size. The soil was dispersed in water. The suspended clay was concentrated by use of ceramic suction filters.

One portion of the concentrated clay was treated with potassium chloride and a second portion was treated with magnesium chloride. The excess salts were removed with ceramic filters. A small amount of distilled water was added to each treated clay and stirred with a magnetic stirrer. An aliquot of this was then diluted to the proper concentration and a 4-ml. aliquot was transferred to a glass slide (1 x 3 inches) and allowed to air-dry. Three slides were made from the Mg- and one from the K-treated clays. One Mg-saturated clay slide was heated to 450° C. in a muffle furnace, a second was treated with ethylene glycol, and the third was air-dried but neither heated nor treated. The K-saturated clay slide was air-dried. Each slide was placed in a General Electric XRD-5 X-ray spectrometer using a copper tube and operating at 50 kv. and 16 ma. The 2 θ angle from 2° to 46° was scanned.

The X-ray patterns were then interpreted essentially as outlined by the S.S.S.A. committee (1956). Approximate quantitative determinations were made according to the method outlined by Johns *et al.* (1954), except that relative amounts were recorded rather than absolute percentages.

Content of heavy minerals greater than 2.87 specific gravity

Twenty to forty grams of the <2-mm. material were treated with hydrogen peroxide to remove organic matter. The samples were then treated with sodium hydrosulfite (Deb procedure, 1950) to remove iron coatings and washed with a weak acid solution to remove possible precipitates and carbonates. The acid-washed samples were made basic to pH 8.5 with sodium hydroxide and shaken overnight in an end-over-end shaker. Sand was divided by sieving into five size fractions: 2 to 1 mm., 1 to 0.5 mm., 0.5 to 0.25 mm., 0.25 to 0.10 mm., and 0.10 to 0.05 mm. The coarse silt (0.05 to 0.02 mm. in diameter) was separated from the fine silt (<0.02 mm. in diameter) by decantation.

Bromoform or tetrabromoethane was used as the heavy liquid to separate the heavy and light minerals. One-gram samples of the silt and sand separates were placed into 50-ml. lusteroid centrifuge tubes. Thirty mls. of the heavy liquid were added and the sample was well stirred and then centrifuged for 10 minutes at 1000 r.p.m. in a No. 2 International Centrifuge. The floating minerals were stirred in the top portion of the tube and recentrifuged.

To effect a division between the floating or light minerals and the heavy minerals at the bottom of the tube, instead of freezing, the lusteroid

tubes were collapsed with tongs near the bottom and the liquid and light minerals poured onto a filter by bending the lusteroid tubes at the top. Any adhering minerals were removed by washing with a hypodermic needle containing some of the heavy liquid. The top of the tube was then cut off and the heavy minerals similarly washed onto a filter. The heavy and light minerals were then washed free of the heavy liquid with acetone and dried, and percentages of each were determined.

Petrographical studies

The 0.10 to 0.05 mm. sand and the 0.05 to 0.02 mm. silt fractions from the above fractionating procedure were subjected to a Franz magnetic separator to remove the magnetic minerals. Representative samples of the heavy minerals from the above size fractions for sixty-one soil horizons were mounted in Canada balsam and examined optically with a petrographical microscope. Refractive index oils were used to identify troublesome minerals.

APPENDIX C: DETAILED PHYSICAL AND CHEMICAL DATA

Profile No. 1 — Fox silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture 1/3 atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17746	0–5	A_1	.5	99.5	10.6	27.9	36.2	11.7	8.1	7.4	2.50	....	2.10	25.6	11.1
17747	5–10	A_2	.2	99.8	5.6	28.6	36.6	8.4	15.3	7.4	.67	....	1.79	22.6	8.9
17748	10–13	A_3-B_1	.1	99.9	4.7	26.9	30.2	11.3	21.8	7.3	.50	....	1.59	24.3	13.4
17749	13–17	B_2	.1	99.9	6.3	24.9	26.3	10.4	27.9	6.5	.40	....	1.40	27.3	15.8
17750	17–22	B_2	.8	99.2	11.3	22.7	25.5	9.5	27.3	5.4	.73	....	1.30	27.7	15.8
17751	22–27	B_3	16.0	84.0	32.2	15.5	16.3	7.6	25.1	6.0	.74	....	1.31	25.8	14.9
17752	27–38	C_1	50.9	49.1	41.5	3.8	6.4	4.5	5.9	7.9	.46	63.2	....	14.3	7.6
17753	38–50+	C_2	71.8	28.2	51.8	2.8	.9	2.7	4.1	8.0	.40	55.1	....	6.9	3.4
17752[a]					65.2	10.2	7.2	3.6	12.3						
17753[a]					81.1	6.8	5.8	.6	4.9						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17746	12.6	6.0	.18	.14	19.0	17.8	100+	89.0	13	15	146
17747	9.5	5.3	.17	.14	15.1	14.5	100+	61.2	7	7	134
17748	12.4	7.8	.27	.18	20.7	19.9	100+	60.1	11	13	170
17749	12.7	9.1	.30	.20	22.5	22.2	100+	58.0	13	17	208
17750	11.3	8.7	.34	.19	20.5	22.4	91	60.9	23	30	254
17751	11.0	8.4	.30	.20	19.9	20.5	97	62.7	17	28	192
17752	....	...	...	...	....	....	...	....	9	120	158
17753	....	...	...	...	....	....	...	....	7	70	80

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
1–4	1.03	41.1	14.6	9.7
6–9	1.25	37.0	10.9	5.8
14–17	1.42	39.0	6.1	1.1
22–25	1.50	39.6	8.6	.2

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 2 — Fox silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17833	0–5	A_1	...	....	45.6	14.4	19.6	4.2	8.1	7.5	(Not determined)		2.44	(Not determined)	
17834	5–8	A_2	...	....	45.9	14.6	21.7	5.4	9.9	7.6			1.82		
17835	8–13	B_1	...	....	41.1	13.9	20.7	7.0	15.4	7.5			1.72		
17836	13–18	B_2	...	....	57.3	6.5	10.7	5.5	19.3	7.5			2.12		
17837	18–24	B_2	...	....	73.2	3.0	4.5	3.7	14.9	7.4			1.92		
17838	24–32	B_{31}	...	....	89.2	1.6	1.7	1.0	5.6	7.2			1.67		
17839	33–45+	C	31.9	68.1	64.7	1.0	1.2	.5	1.3	7.2			....		
17839[a]					94.8	2.2	1.7	.4	.6						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17833	13.2	5.4	.19	.11	18.9	17.6	100+	143.1	14	40	48
17834	8.0	4.4	.10	.08	12.6	11.8	100+	77.1	13	16	131
17835	8.8	5.1	.23	.10	14.3	13.8	100+	61.6	20	22	200
17836	10.2	4.8	.27	.11	15.4	15.2	100+	61.3	28	40	232
17837	7.3	3.8	.20	.09	11.4	11.0	100+	59.1	36	52	250
17838	2.5	1.5	.08	.04	4.1	4.0	100+	60.6	26	48	185
17839	....	...	...	...	....	....	...	....	6	42	40

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
½–3½	1.26	35.6	13.9	13.3
7–10	1.40	29.2	14.0	9.7
16–19	1.54	25.7	14.2	8.8
24–27	1.60	14.7	19.9	15.3

Profile No. 3 — Fox silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17840	0–3	A_1	.1	99.9	45.7	13.8	25.3	5.6	4.7	6.7	4.43	....	(Not determined)	24.5	9.2
17841	3–7	A_2	.1	99.9	47.1	14.2	27.6	5.7	3.9	6.1	1.27	....		17.9	4.0
17842	7–9	A_3	.1	99.9	45.2	14.5	26.9	5.7	7.1	5.7	.78	....		17.8	5.0
17843	9–13	B_1	.1	99.9	46.8	11.4	21.3	7.9	11.6	5.5	.68	....		19.1	7.7
17844	13–21	B_{21}	2.4	97.6	48.1	8.4	15.4	7.6	19.9	5.2	.64	....		21.5	10.8
17845	21–27	B_{22}	7.4	92.6	61.5	3.2	6.1	6.2	22.7	5.3	.46	....		20.6	11.6
17846	27–30	B_{23}	20.2	79.8	63.2	3.5	5.8	7.3	19.7	5.5	.43	....		18.9	10.9
17847	30–37	B_3	60.3	39.7	52.6	3.1	4.6	3.7	11.6	7.4	....	19.6		14.5	7.3
17848	37–50+	C	61.8	38.2	65.6	3.3	3.1	.7	2.8	7.8	....	26.3		4.9	1.8
17847[a]					69.6	7.7	5.6	6.7	10.0						
17848[a]					85.8	5.6	4.3	2.5	1.1						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17840	(Not determined)				12.8	13.3	96	129.1	32	40	208
17841					5.9	6.9	86	71.9	16	16	126
17842					6.4	7.8	82	60.9	8	8	166
17843					10.5	12.0	88	61.5	6	6	192
17844					13.9	17.4	80	63.3	8	9	241
17845					15.3	17.8	86	61.6	10	10	250
17846					15.1	16.1	94	59.6	8	18	216
17847					....	....	..	....	8	59	185
17848					....	....	..	....	10	79	88

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
3–6	1.60	32.4	4.5	.65
12–15	1.53	34.6	3.5	.34
21–24	1.60	37.5	4.5	.17
28–31	1.56	34.8	7.4	1.00

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 4 — McHenry silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17768	0–4	A_1	.4	99.6	14.2	29.1	33.7	6.9	4.0	7.2	3.77	....	2.36	28.0	11.6
17769	4–13	A_2	1.1	98.9	13.1	30.1	40.2	8.3	3.6	6.8	.58	....	.97	19.1	4.6
17770	13–17	B_1	1.0	99.0	15.3	24.2	30.9	10.3	16.5	5.0	.38	....	.94	22.1	10.7
17771	17–27	B_{21}	5.2	94.8	23.3	21.2	21.0	9.9	22.6	5.0	.37	....	1.09	24.0	13.3
17772	27–33	B_{22}	14.3	85.7	62.3	8.7	5.3	4.9	15.9	5.5	.30	....	.96	16.2	9.1
17773	33–37	B_3	6.8	93.2	72.0	11.6	2.6	4.3	11.5	6.1	.39	....	1.16	13.0	7.2
17774	37+	C	36.3	63.7	51.0	9.6	3.7	3.8	2.9	8.0	.15	45.1	....	8.1	2.7
17774[a]					67.5	14.3	10.8	2.6	4.0						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17768	15.6	6.6	.21	.14	22.5	19.6	100+	179.8	54	105	158
17769	3.0	3.1	.07	.09	6.2	6.8	92	57.1	82	120	40
17770	5.1	5.4	.19	.11	10.8	16.2	67	60.4	54	72	158
17771	7.5	6.9	.24	.14	14.7	19.8	74	60.9	32	50	217
17772	5.4	5.6	.19	.11	11.3	12.8	88	61.5	42	74	170
17773	5.2	4.5	.18	.12	10.0	10.1	99	63.9	30	78	134
17774	....	...	...	...	....	....	..	....	14	200+	40

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
½–3½	1.19	44.4	10.8	12.3
6–9	1.43	35.5	7.8	.7
20–23	1.53	34.8	8.9	1.9
33–36	1.33	35.8	14.2	5.1

Profile No. 5 — McHenry silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17824	0–2	A_1	(Not determined)		29.7	21.8	30.5	5.0	5.4	6.6	(Not determined)		2.95	(Not determined)	
17825	2–4	A_{21}			32.2	23.6	33.0	5.4	3.6	5.8			2.93		
17826	4–7	A_{22}			30.4	24.7	34.4	6.6	2.7	5.5			1.91		
17827	7–9	A_3–B_1			21.4	24.6	33.0	7.4	12.5	5.2			1.66		
17828	9–16	B_{21}			17.2	21.9	28.6	9.5	21.4	5.2			1.31		
17829	16–22	B_{22}			29.3	16.8	23.0	7.9	22.1	5.2			1.23		
17830	22–28	B_{22}			41.8	11.5	19.0	6.0	18.9	5.3			1.28		
17831	31–34	C_1			38.0	8.8	12.4	4.3	10.5	7.7			....		
17832	34–41+	C_2			40.4	9.4	9.1	2.1	5.6	8.0			....		
17831[a]					48.9	15.6	18.8	8.1	8.3						
17832[a]					56.1	19.2	15.9	4.5	3.7						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17824	12.1	4.1	1.38	.18	17.8	19.6	91	188.5	71	136	300+
17825	4.1	1.4	.61	.07	6.1	8.2	75	91.1	52	71	300+
17826	2.1	1.1	.20	.07	3.5	5 4	64	58.1	54	87	224
17827	4.8	2.9	.22	.11	8.0	11.1	72	55.8	25	30	88
17828	8.1	6.2	.35	.13	14.8	19 1	77	61.8	22	30	172
17829	7.4	6.0	.32	.11	13.8	17.9	77	59.7	26	31	200
17830	6 4	5.0	.26	.10	11.8	14.1	84	56.6	36	59	172
17831	....	...	...	...	....	....	..	....	14	204+	131
17832	....	...	...	...	....	....	..	....	6	162	148

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
0–3	1.30	40.6	6.2	.8
5–8	1.58	31.2	4.0	.3
19–22	1.65	32.6	3.3	.3
38–41	1.88	26.8	3.2	.1

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 6 — Miami silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17731	0–3	A_1	.7	99.3	29.5	21.5	30.1	6.9	6.0	7.1	2.44	....	3.08	22.5	8.0
17732	3–7	A_{21}	.2	99.8	31.3	15.4	31.7	8.1	4.3	5.7	.80	....	1.78	17.4	4.5
17733	7–10	A_{22}	.5	99.5	30.7	15.6	32.0	9.1	7.0	4.8	.50	....	.50	17.1	5.4
17734	10–15	B_1	1.5	98.5	30.3	17.0	28.9	7.9	14.2	4.7	.42	....	.69	18.7	8.7
17735	15–18	B_2	3.1	96.9	27.1	12.5	26.4	9.7	20.4	4.7	.57	....	1.10	21.0	11.7
17736	18–22	B_2	4.5	95.5	29.7	11.3	26.1	9.9	20.8	5.0	.54	....	1.46	20.9	12.1
17737	22–29	B_3	2.7	97.3	31.2	10.5	25.3	9.9	20.4	6.3	.44	38.0	1.86	21.7	12.4
17738	29–34	C_1	6.0	94.0	26.3	9.5	22.8	5.5	14.2	8.0	.41	37.8	....	17.5	9.0
17739	34+	C_2	6.0	94.0	26.3	10.7	21.4	6.6	11.0	8.0	.36	37.0	....	16.2	8.0
17738[a]					33.4	13.4	29.4	11.1	10.5						
17739[a]					34.0	14.3	31.2	10.4	9.2						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17731	11.4	3.7	.28	.14	15.5	13.4	100+	103.9	23	48	244
17732	3.2	1.8	.14	.03	5.3	6.9	76	55.6	46	58	170
17733	.9	1.8	.10	.03	2.8	7.1	39	44.1	23	34	110
17734	2.0	2.9	.17	.04	5.2	11.0	47	49.8	15	16	158
17735	4.4	4.0	.25	.11	8.8	15.2	58	54.1	8	9	208
17736	6.3	4.3	.24	.07	10.9	15.0	73	49.0	8	9	217
17737	9.3	5.0	.23	.18	14.7	13.3	100+	43.9	8	62	164
17738	...	...	...	...	....	....	...	....	7	70	122
17739	...	...	...	...	....	....	...	....	7	23	122

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
0–3	1.23	40.4	11.2	6.0
5–8	1.52	34.9	5.8	.3
15–18	1.58	34.0	7.9	1.5
24–27	1.58	37.0	4.8	.2
38–41	1.81	32.0	2.4	.1

Profile No. 7 — Miami silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17815	0–3	A_1	(Not determined)		31.3	20.4	31.0	5.3	5.1	5.9	3.32	....	3.81	(Not determined)	
17816	3–5	A_{21}			33.6	22.1	32.8	5.2	4.0	4.9	1.13	....	.05		
17817	5–10	A_{22}			33.2	23.7	32.1	6.2	3.6	5.1	.56	....	.08		
17818	10–15	B_1			33.7	19.8	28.6	8.3	8.6	5.0	.43	....	.96		
17819	15–22	B_{21}			35.4	15.1	20.1	10.0	18.5	5.0	.51	....	.93		
17820	22–28	B_{22}			39.4	14.4	16.4	9.3	20.3	5.1	.37	....	.96		
17821	28–34	B_{22}			40.7	11.5	16.6	10.2	20.4	5.4	.38	....	1.03		
17822	34–39	B_3			41.3	9.8	15.1	7.5	14.1	7.4	....	12.8	....		
17823	39–54+	C			35.8	8.3	12.3	5.8	9.6	7.7	....	27.8	....		
17822[a]					46.2	13.2	16.4	10.7	13.6						
17823[a]					47.3	17.0	18.5	9.7	7.6						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17815	6.1	1.6	.27	.67	8.6	13.9	62	133.6	30	34	300+
17816	.1	2.0	.10	.07	2.3	6.6	34	71.7	40	53	148
17817	.1	1.3	.09	.14	1.6	5.0	32	51.0	40	54	72
17818	2.2	2.3	.14	.06	4.7	8.4	55	49.7	48	61	148
17819	4.1	4.4	.28	.09	8.8	14.7	60	51.6	59	87	216
17820	4.9	5.1	.30	.10	10.4	15.4	67	52.0	87	128	232
17821	6.2	6.0	.31	.13	12.6	15.2	83	49.7	79	152	232
17822	...	...	...	...	....	....	..	....	18	204+	172
17823	...	...	...	...	....	....	..	....	10	204+	136

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
0–3	1.09	40.7	12.9	8.7
6–9	1.53	30.9	7.1	2.1
17–20	1.60	33.6	2.9	.5
30–33	1.57	35.6	2.9	.2
48–51	1.80	31.5	1.5	.1

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 8 — Blount silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample: >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	CaCO₃ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17495	0–4	A_1	.2	99.8	9.8	23.8	42.6	12.3	6.0	5.6	3.03	....	3.47	28.6	9.4
17496	4–7	A_2	.2	99.8	10.1	26.2	42.7	12.6	4.9	5.2	1.44	....	3.61	24.4	6.9
17497	7–10	A_3	.2	99.8	9.9	23.3	44.0	12.5	8.0	5.3	.73	....	2.44	23.1	7.3
17498	10–14	B_1	.5	99.5	10.0	19.7	38.6	15.2	14.8	4.7	.49	....	1.92	23.1	11.1
17499	14–20	B_{21}	.4	99.6	10.6	12.3	32.1	17.7	25.8	4.8	.66	....	1.35	26.3	15.8
17500	20–25	B_{22}	.7	99.3	10.0	8.9	31.0	19.8	27.2	6.1	.70	....	1.47	27.9	17.4
17501	25–30	C	4.4	95.6	11.4	9.2	28.1	17.7	17.0	7.7	.54	22.7	....	24.1	13.4
17502	30–36	C	8.7	91.3	12.6	9.4	28.8	17.0	11.5	7.8	.45	30.2	....	21.5	11.6
17503	36–42+	C	6.7	93.3	13.4	10.1	29.1	17.3	9.7	8.0	.40	31.6	....	21.1	11.2
17501ª					15.3	14.4	36.8	19.4	14.8						
17052ª					16.0	14.9	40.6	18.5	10.3						
17503ª					16.0	15.9	40.3	18.4	9.9						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.ᵇ	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17495	9.2	2.7	.41	.09	12.4	16.4	75	89.6	17	42	300+
17496	6.6	1.8	.22	.08	8.7	12.0	73	68.6	12	20	200
17497	6.0	2.5	.20	.13	8.8	11.2	78	54.6	11	22	170
17498	6.2	3.2	.28	.15	9.9	16.4	61	54.7	12	23	217
17499	9.2	6.8	.38	.18	16.6	21.2	78	48.7	8	17	244
17500	12.2	8.3	.37	.24	21.1	20.0	100+	42.6	23	78	184
17501	....	...	...	...	....	....	...	....	19	152	146
17502	....	...	...	...	....	....	...	....	19	46	122
17503	....	...	...	...	....	....	...	....	17	23	105

Core sample data

Depth	Bulk dens.	Cap. pores	Noncap. pores	Hydr. cond.
in.		%	%	*in./hr.*
0–3	1.08	40.8	14.3	5.6
4–7	1.31	41.4	6.8	.7
7–10	1.44	36.8	7.4	.4
10–13	1.46	37.1	7.0	.5
14½–17½	1.44	38.6	7.9	1.7
20–23	1.40	40.2	6.7	2.0
25–28	1.52	36.7	8.0	.9
30–33	1.61	33.9	6.8	.9
36–39	1.67	34.3	6.0	.3

Profile No. 9 — Blount silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample: >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	CaCO₃ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17520	0–7	A_p	2.7	97.3	22.2	15.4	38.1	11.8	7.2	5.3	1.99	....	2.40	24.2	8.3
17521	7–10	A_2	19.5	80.5	23.7	15.1	37.6	13.0	7.9	5.1	.60	....	3.03	20.7	7.0
17522	10–13	B_1	27.7	72.3	21.8	10.0	29.4	18.1	17.4	4.9	.51	....	1.88	23.6	12.6
17523	13–19	B_{21}	1.6	98.4	10.6	6.7	29.3	22.6	27.6	4.7	.49	....	1.52	27.3	17.8
17524	19–25	B_{22}	.9	99.1	9.3	7.4	32.6	21.2	26.5	6.4	.56	....	1.76	26.9	18.0
17525	25–31	C_1	1.9	98.1	9.1	6.5	29.3	22.0	16.6	7.7	.48	20.0	....	24.0	15.3
17526	31–37	C_2	2.4	97.6	9.0	6.4	31.1	20.4	11.9	7.8	.47	26.9	....	21.8	13.6
17527	37–43+	C_2	3.4	96.6	8.9	5.8	29.9	20.9	11.9	8.0	.41	27.2	....	22.6	13.9
17525ª					10.8	9.0	40.2	25.0	13.3						
17526ª					10.6	11.2	42.7	24.4	10.5						
17527ª					10.6	10.3	42.0	26.1	10.1						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.ᵇ	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17520	5.6	2.3	.33	.09	8.4	10.0	84	52.6	7	13	300+
17521	5.0	1.7	.19	.17	6.9	8.2	84	39.2	6	6	122
17522	6.9	3.7	.26	.13	11.0	14.4	76	40.6	5	5	177
17523	8.6	5.7	.37	.18	14.8	18.0	77	35.8	5	5	226
17524	11.8	6.7	.33	.20	19.1	16.0	100+	33.5	7	74	200
17525	....	...	...	...	....	....	...	....	5	70	152
17526	....	...	...	...	....	....	...	....	7	26	146
17527	....	...	...	...	....	....	...	....	6	12	146

Core sample data

Depth	Bulk dens.	Cap. pores	Noncap. pores	Hydr. cond.
in.		%	%	*in./hr.*
0–3	1.41	39.8	3.8	.3
7–10	1.55	32.7	5.2	2.6
10–13	1.52	37.8	3.1	.8
13–16	1.51	41.6	2.3	.1
19–22	1.54	41.9	2.2	.2
25½–28½	1.56	38.9	2.3	.04
31–34	1.79	35.8	1.5	.04

ª Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
ᵇ Not corrected for organic matter.

Profile No. 10 — Eylar silt loam

Lab. No.	Depth	Horizon	Based on entire sample >2 mm.	Based on entire sample <2 mm.	Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17760	0–3	A_{11}	.4	99.6	12.0	16.7	41.1	14.4	6.0	7.3	3.96	....	1.93	33.0	13.3
17761	3–5	A_{12}	.5	99.5	13.1	16.9	45.1	14.1	5.8	7.3	2.34	....	1.78	27.2	9.0
17762	5–9	A_2	1.7	98.3	13.0	17.4	47.5	15.7	4.6	7.1	.88	....	1.31	24.3	6.3
17763	9–14	B_1	1.2	98.8	9.6	12.1	39.5	19.8	14.8	5.2	.52	....	.80	24.4	12.0
17764	14–21	B_2	.7	99.3	7.4	6.7	28.6	23.3	28.4	4.5	.50	....	.83	27.9	18.1
17765	21–26	B_3	.8	99.2	8.8	5.9	30.4	21.4	27.7	5.8	.45	....	.74	26.1	17.3
17766	26–45	C_1	4.9	95.1	12.0	6.0	25.2	18.2	18.9	7.8	.35	19.3	....	23.7	15.0
17767	45–50+	C_2	3.9	96.1	12.0	11.3	26.7	13.7	12.4	8.1	.32	28.7	....	21.7	11.8
17766[a]					16.7	8.6	32.3	26.3	15.3						
17767[a]					16.7	15.1	37.9	19.9	9.2						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17760	14.3	7.4	.60	.23	22.5	21.0	100+	102.9	5	54	300+
17761	9.8	5.5	.35	.16	15.9	14.6	100+	73.4	3	20	276
17762	5.1	3.9	.30	.04	9.3	9.8	95	48.3	7	9	244
17763	3.7	4.6	.36	.10	8.8	12.8	68	37.0	5	7	276
17764	4.8	5.8	.40	.17	11.1	18.4	52	35.6	5	5	217
17765	7.0	9.4	.25	.15	16.9	16.0	100+	32.6	5	62	152
17766	....	...	...	...	....	....	...	....	4	152	134
17767	....	...	...	...	....	....	...	....	3	46	90

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
½–3½	1.01	42.3	18.0	22.2
6–9	1.48	35.5	9.1	4.3
16–19	1.55	39.8	4.2	.4
28–31	1.62	37.7	4.1	.1

Profile No. 11 — Eylar silt loam

Lab. No.	Depth	Horizon	Based on entire sample >2 mm.	Based on entire sample <2 mm.	Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17754	0–3	A_1	.1	99.9	5.8	25.5	40.4	13.4	8.4	6.6	2.59	....	2.62	30.2	9.4
17755	3–9	A_2	.2	99.8	5.2	22.9	40.9	17.6	11.3	5.2	.82	....	1.31	24.6	9.5
17756	9–13	B_1	.4	99.6	4.2	10.0	28.7	24.3	30.8	4.9	.81	....	.72	28.0	17.1
17757	13–18	B_2	.2	99.8	3.6	4.5	24.1	27.0	36.0	6.3	.71	....	.75	31.1	19.8
17758	18–28	C_1	4.4	95.6	3.0	4.0	19.6	23.6	26.2	7.8	.49	22.3	....	26.2	17.0
17759	28–50+	C_2	3.1	96.9	2.2	3.8	17.0	27.5	25.2	8.1	.64	27.8	....	33.0	17.9
17758[a]					7.1	6.4	29.9	34.9	21.1						
17759[a]					5.5	5.3	28.5	39.4	20.5						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17754	11.0	4.2	.24	.20	15.7	16.2	96	74.3	9	13	208
17755	5.1	3.9	.16	.11	9.2	13.7	67	47.4	9	9	146
17756	7.2	10.0	.36	.17	17.8	22.5	79	40.8	7	7	235
17757	9.9	13.2	.41	.23	23.7	21.8	100+	34.6	9	62	217
17758	....	...	...	...	....	....	...	....	5	105	152
17759	....	...	...	...	....	....	...	....	6	22	158

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
½–3½	1.15	41.2	11.2	5.9
5–8	1.42	37.6	6.0	1.6
13–16	1.32	44.8	3.7	.2
28–31	1.59	35.5	5.8	1.0

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 12 — Beecher silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17485	0–6	A_1	.1	99.9	7.4	23.3	43.4	10.3	10.1	5.9	3.25	....	4.84	29.2	12.5
17486	6–9	A_2	.05	99.95	7.8	24.3	46.1	8.6	11.2	5.4	1.39	....	4.38	24.8	8.2
17487	9–13	A_3	.06	99.94	7.8	25.2	42.6	8.5	14.3	4.7	.76	....	2.61	24.9	9.5
17488	13–18	B_1	.03	99.97	9.0	20.9	34.5	10.1	23.3	4.8	.73	....	1.76	26.1	13.9
17489	18–22	B_2	.3	99.7	15.7	17.0	25.3	10.1	30.8	4.5	.65	....	1.58	29.2	17.5
17490	22–27	B_2	1.3	98.7	31.3	12.0	18.2	11.7	25.5	4.9	.64	....	1.60	26.0	15.5
17491	27–31	B_3	.7	99.3	22.7	10.4	28.2	16.4	21.5	6.3	.51	....	1.70	25.2	15.1
17492	31–37	C	5.1	94.9	9.4	9.8	27.6	13.7	17.5	7.7	.51	25.7	....	21.5	12.2
17493	37–43	C	8.4	91.6	9.0	8.1	26.7	14.7	13.0	7.8	.50	33.3	....	20.3	10.7
17494	43–49+	C	5.3	94.7	12.5	9.3	27.9	14.6	11.8	8.0	.51	33.4	....	20.8	10.7
17492[a]					15.0	14.9	40.4	19.3	10.8						
17493[a]					15.3	14.3	42.8	18.4	8.6						
17494[a]					16.2	15.4	42.1	17.4	9.2						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17485	13.8	2.9	.41	.17	17.2	20.0	86	98.0	19	34	300+
17486	8.9	2.0	.19	.11	11.2	14.0	80	70.7	13	17	184
17487	7.0	2.7	.20	.11	10.0	15.8	63	69.3	19	20	185
17488	9.1	5.2	.30	.17	14.7	22.8	65	68.3	15	19	226
17489	12.4	7.9	.41	.19	20.9	28.4	73	70.1	12	15	276
17490	11.8	7.4	.37	.21	19.7	22.6	87	60.8	9	17	254
17491	12.4	7.3	.27	.19	20.2	17.8	100+	47.0	8	102	134
17492	....	...	...	...	....	....	...	....	4	62	110
17493	....	...	...	...	....	....	...	....	4	42	110
17494	....	...	...	...	....	....	...	....	5	40	122

Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
0–3	1.12	42.5	12.2	2.7
6–9	1.35	40.9	6.6	.3
9½–12½	1.36	41.3	6.8	.4
13½–16½	1.40	43.4	6.6	.5
18½–21½	1.43	45.9	8.0	1.3
22½–25½	1.52	39.4	6.9	.6
27–30	1.50	40.8	5.7	.2
31½–34½	1.72	35.2	5.6	.2
37–40	1.80	32.7	4.3	.1
43–46	1.77	32.8	4.0	.1

Profile No. 13 — Beecher silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17512	0–7	A_p	.4	99.6	14.3	12.6	37.9	15.1	12.3	5.4	3.46	....	1.74	29.8	13.5
17513	7–11	A_2	3.0	97.0	14.1	12.3	38.8	17.7	12.7	4.9	1.53	....	2.70	24.1	11.6
17514	11–14	B_1	5.2	94.8	11.9	8.6	33.4	21.6	20.5	4.7	1.10	....	1.77	26.3	15.4
17515	14–18	B_{21}	1.0	99.0	8.4	5.5	26.7	22.4	32.4	5.0	.93	....	1.61	30.3	19.6
17516	18–22	B_{22}	2.8	97.2	8.9	6.3	30.1	22.1	29.7	6.0	.75	....	1.64	28.8	18.4
17517	22–28	C_1	1.3	98.7	8.4	6.3	29.8	22.3	24.0	7.5	.65	10.5	....	27.6	17.6
17518	28–34	C_2	1.9	98.1	8.4	5.9	28.8	21.2	16.8	7.8	.48	21.0	....	23.3	14.9
17519	34–40+	C_2	2.9	97.1	10.5	5.9	29.5	20.3	13.6	7.8	.34	22.7	....	22.1	13.7
17517[a]					10.0	8.4	35.1	28.3	17.7						
17518[a]					11.7	10.0	39.5	25.7	12.8						
17519[a]					13.2	11.0	41.5	24.0	10.2						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17512	8.8	5.1	.85	.18	14.9	17.2	87	62.8	30	38	300+
17513	6.7	2.5	.60	.16	9.9	14.4	69	47.4	15	15	300+
17514	8.1	4.6	.54	.15	13.4	18.4	73	43.7	12	13	300+
17515	12.0	7.5	.52	.17	20.2	23.4	86	43.5	9	9	300
17516	12.8	7.8	.38	.18	21.2	18.0	100+	34.7	9	34	200
17517	....	...	...	...	....	....	...	....	7	200+	134
17518	....	...	...	...	....	....	...	....	9	44	128
17519	....	...	...	...	....	....	...	....	5	34	122

Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
0–3	1.26	45.2	6.0	2.0
7–10	1.43	37.4	5.5	1.9
11–14	1.46	38.1	4.7	1.4
14–17	1.40	42.9	3.1	.7
18–21	1.47	45.0	1.7	.1
22–25	1.52	41.3	2.3	.1
28–31	1.56	40.1	2.5	.1

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 14 — Frankfort silt loam to silty clay loam

Lab. No.	Depth	Horizon	Based on entire sample >2 mm.	Based on entire sample <2 mm.	Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay <2μ	pH	Org. carb.	CaCO3 equiv.	Ca/Mg	Moisture 1/3 atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%		%	%		%	%
S51 Ill-99-1-1	0–6	A_p	.5	99.5	17.6	15.0	33.1	34.3	5.8	2.42	(Not determined)		(Not determined)	
S51 Ill-99-1-2	6–12	B_1	2.0	98.0	17.2	12.3	30.5	40.0	6.0	1.62				
S51 Ill-99-1-3	12–22	B_2	.5	99.5	7.6	6.0	27.2	59.2	6.6	.86				
S51 Ill-99-1-4	22+	C	2.0	98.0	10.5	10.9	35.7	42.9	8.0	.30				

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
S51 Ill-99-1-1	(Not determined)										
S51 Ill-99-1-2											
S51 Ill-99-1-3											
S51 Ill-99-1-4											

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
(Not determined)				

Profile No. 15 — Warsaw silt loam

Lab. No.	Depth	Horizon	Based on entire sample >2 mm.	Based on entire sample <2 mm.	Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	CaCO3 equiv.	Ca/Mg	Moisture 1/3 atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17603	0–5	A_1	.2	99.8	13.9	21.1	29.7	7.8	15.4	7.4	4.85	....	1.81	32.0	19.2
17604	5–12	A_1	1.2	98.8	16.3	19.8	29.3	6.9	16.8	6.8	2.59	....	1.19	26.7	12.9
17605	12–15	A_3	.5	99.5	16.0	21.8	29.2	8.1	17.9	5.8	1.70	....	1.96	24.8	11.3
17606	15–19	B_1	1.0	99.0	12.6	23.8	30.8	9.8	18.4	5.7	1.36	....	1.82	25.8	11.5
17607	19–24	B_{21}	.6	99.4	10.8	24.2	30.8	10.4	21.4	5.5	1.01	....	1.46	26.0	12.8
17608	24–29	B_{22}	8.6	91.4	31.1	16.5	20.7	7.9	21.0	5.8	.67	....	1.52	22.2	11.4
17609	29–36	B_3	16.0	84.0	64.0	10.3	11.1	3.1	10.3	6.1	.36	....	1.68	11.8	5.3
17610	36–44	C_1	48.0	52.0	54.9	7.0	5.8	1.9	3.1	8.0	.21	33.5	....	6.9	2.1
17611	44–50+	C_1	43.4	56.6	51.0	6.6	6.1	1.9	2.3	8.2	.13	33.2	....	6.6	1.8
17610[a]					71.9	12.1	10.9	2.5	1.9						
17611[a]					70.1	14.5	10.6	1.5	1.7						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17603	18.3	10.1	.97	.20	29.5	30.0	98	129.3	8	23	300+
17604	12.0	7.1	.56	.12	19.8	21.6	92	91.1	7	14	300+
17605	9.0	4.6	.25	.10	13.9	18.7	74	71.9	8	13	208
17606	9.1	5.0	.21	.11	14.4	19.0	76	67.4	6	9	172
17607	10.4	7.1	.23	.13	17.8	21.2	84	66.7	4	5	166
17608	10.0	6.6	.25	.14	16.9	19.4	87	67.1	7	11	178
17609	4.7	2.8	.13	.09	7.7	9.8	78	73.1	14	32	121
17610	....	...	...	...	....	....	...	....	..	..	56
17611	....	...	...	...	....	....	...	....	..	..	52

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
2–5	0.98	53.6	7.8	18.8
8–11	1.15	38.3	16.1	8.0
20–23	1.41	39.0	9.7	3.0
25–28	1.46	33.8	12.6	3.3

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 16 — Warsaw silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17612..........	0–5	A_1	.2	99.8	9.9	28.5	27.3	5.9	17.6	7.7	2.98	....	2.44	28.2	13.7
17613..........	5–10	A_1	.1	99.9	7.0	26.5	30.3	8.6	20.8	7.6	2.12	....	2.00	27.5	13.3
17614..........	10–13	A_3–B_1	.3	99.7	4.6	25.6	30.3	10.1	24.8	7.3	1.34	....	1.43	27.8	12.2
17615..........	13–19	B_2	.2	99.8	4.1	26.0	31.0	10.8	24.7	5.6	.91	....	1.48	28.1	14.1
17616..........	19–25	B_2	.4	99.6	12.4	27.3	29.0	10.4	17.3	5.5	.51	....	1.21	25.0	11.0
17617..........	25–29	B_3	4.2	95.8	40.3	16.3	19.3	6.9	13.7	5.8	.54	....	1.43	18.3	8.0
17618..........	29–40	C	81.3	18.7	61.4	2.7	2.3	.7	2.0	7.8	.25	32.3	....	4.2	1.7
17619..........	40–50+	C	82.2	17.8	59.6	3.6	2.8	1.0	1.8	8.3	.18	35.0	....	3.7	1.5
17618[a]..........					86.1	6.5	3.7	.1	1.7						
17619[a]..........					86.8	6.6	4.0	.1	1.4						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17612..........	17.8	7.3	.26	.22	25.6	23.8	100+	101.3	9	20	148
17613..........	15.8	7.9	.22	.22	24.1	24.0	100+	82.8	7	9	121
17614..........	14.0	9.8	.27	.21	24.3	25.0	97	71.6	8	11	154
17615..........	11.4	7.7	.30	.18	19.5	23.8	82	66.5	9	7	166
17616..........	8.0	6.6	.22	.12	15.7	20.4	77	75.3	8	12	126
17617..........	7.0	4.9	.18	.11	12.2	14.4	85	70.9	12	25	131
17618..........	....	...	...	...	....	....	...	....	..	..	40−
17619..........	....	...	...	...	....	....	...	....	..	..	40−

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
1–4	1.02	39.1	21.0	23.8
6–9	1.14	44.1	11.0	16.4
15–18	1.26	37.7	12.0	6.0
21–24	1.36	37.9	8.8	2.3

Profile No. 17 — Ringwood silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17595..........	0–4	A_1	.4	99.6	28.1	19.5	25.2	6.2	11.8	7.3	3.56	(Not	2.08	24.3	14.5
17596..........	4–9	A_1	.1	99.9	26.2	18.3	27.2	7.2	14.6	7.3	2.32	deter-	2.00	22.4	11.6
17597..........	9–11	A_3	.1	99.9	25.8	18.7	26.8	7.8	15.2	7.3	1.86	mined)	1.61	22.8	11.1
17598..........	11–17	B_1	1.4	98.6	29.5	15.3	25.4	7.8	16.7	7.0	1.07		1.23	21.5	10.2
17599..........	17–25	B_2	6.7	93.3	46.6	10.2	18.5	6.7	14.6	6.2	.67		1.54	17.7	8.3
17600..........	25–29	B_{31}	8.3	91.7	53.3	10.6	16.8	6.4	11.0	5.9	.32		1.08	14.7	6.7
17601..........	29–34	B_{32}	6.1	93.9	57.1	9.1	15.5	5.1	9.9	6.3	.46		1.09	13.5	5.9
17602..........	34–48+	C	14.4	85.6	41.4	7.2	11.2	2.7	5.5	8.2	.23		....	11.5	3.6
17602[a]..........					55.5	16.5	19.5	4.1	3.8						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17595..........	15.6	7.5	.25	.12	23.5	21.2	100+	117.7	7	12	126
17596..........	12.8	6.4	.19	.14	19.5	18.0	100+	82.6	8	10	106
17597..........	10.3	6.4	.16	.13	17.0	17.8	96	77.4	6	9	111
17598..........	8.5	6.9	.17	.11	15.7	17.2	91	70.2	5	7	126
17599..........	6.8	4.4	.18	.10	11.4	12.8	89	60.1	3	6	136
17600..........	4.0	3.7	.12	.08	7.9	9.4	84	54.0	4	11	142
17601..........	3.7	3.4	.10	.08	7.3	7.6	96	50.7	8	23	101
17602..........	....	...	...	...	....	....	...	....	..	..	48

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
1–4	1.14	(Not	13.5	10.7
8–11	1.29	deter-	9.8	3.2
14–17	1.26	mined)	14.3	11.4
20–23	1.41		11.8	5.3
28–31	1.45		11.4	4.9
40–43	1.76		4.9	.7

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 18 — Ringwood silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17620	0–4	A_1	.6	99.4	28.4	19.0	23.4	5.0	13.6	7.6	3.33	....	2.30	23.8	13.3
17621	4–8	A_1	1.8	98.2	27.6	19.6	24.7	6.0	14.8	7.7	2.46	....	2.08	22.3	11.3
17622	8–10	A_3	.2	99.8	20.8	19.0	24.8	7.8	19.6	7.6	1.72	....	1.78	24.4	12.5
17623	10–13	B_1	.9	99.1	21.9	18.1	24.2	7.9	21.5	7.5	1.34	....	1.40	24.0	12.4
17624	13–17	B_2	2.8	97.2	35.2	13.6	20.0	6.5	18.5	7.5	1.02	....	1.28	21.2	10.6
17625	17–20	B_2	4.9	95.1	44.6	16.3	16.0	5.6	15.0	7.6	.77	....	1.34	18.6	8.7
17626	20–25	B_3	11.1	88.9	56.2	13.3	14.5	4.5	9.5	7.6	.71	....	1.34	13.7	5.7
17627	25–36	C	18.4	81.6	44.0	8.1	10.5	2.6	3.9	8.1	.25	31.3	....	9.4	2.7
17628	36–48+	C	26.2	73.8	45.1	7.9	10.1	2.5	3.3	8.3	.17	31.5	....	9.3	2.4
17627[a]					60.8	15.1	16.6	4.8	2.5						
17628[a]					61.8	14.6	17.1	3.3	2.0						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17620	16.0	7.0	.28	.11	23.4	23.0	100+	123.6	8	20	172
17621	13.8	6.6	.19	.12	20.7	21.2	98	101.9	4	14	121
17622	14.2	8.0	.24	.12	22.6	23.4	96	85.4	3	9	131
17623	13.0	9.3	.21	.11	22.6	24.2	93	82.3	5	8	106
17624	10.7	8.4	.22	.10	19.4	20.2	96	80.8	6	9	131
17625	8.9	6.6	.19	.09	15.8	16.5	96	80.1	4	8	88
17626	6.2	4.6	.13	.06	11.0	10.7	100+	76.4	3	18	92
17627	....	...	...	...	....	....	...	....	..	..	40−
17628	....	...	...	...	....	....	...	....	..	..	40−

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
2–5	1.17	42.1	12.6	14.1
7–10	1.25	42.5	7.8	10.1
10–13	1.24	39.3	10.0	10.0
15–18	1.38	36.0	9.8	5.6
30–33	1.68	28.5	8.9	1.5

Profile No. 19 — Saybrook silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17775	0–11	A_1	.2	99.8	5.0	21.7	38.1	10.7	18.6	7.3	2.65	...	2.68	29.5	15.3
17776	11–17	A_3	.3	99.7	5.0	20.7	37.8	12.0	20.1	5.7	1.92	....	2.16	28.0	15.0
17777	17–21	B_1	.2	99.8	5.0	17.7	35.4	12.3	26.7	5.7	1.36	....	1.62	29.8	17.4
17778	21–28	B_2	.2	99.8	5.4	16.3	33.7	10.3	28.7	5.7	1.06	....	1.56	31.6	18.1
17779	28–35	B_3	2.5	97.5	36.9	13.2	20.3	7.2	18.6	6.2	.88	....	1.52	21.2	11.4
17780	35–50+	C	9.4	90.6	14.7	9.1	26.4	8.9	12.0	7.9	....	26.9	....	18.8	9.5
17780[a]					23.4	13.6	38.9	13.3	10.0						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17775	17.2	6.4	.54	.16	24.3	27.2	89	92.8	15	20	300+
17776	13.8	6.4	.33	.19	20.7	25.2	82	78.5	12	13	235
17777	14.4	8.9	.40	.22	23.9	28.1	85	72.0	9	10	217
17778	14.4	9.2	.44	.25	24.3	28.8	84	73.8	10	12	254
17779	8.7	5.7	.29	.16	14.9	15.7	95	60.8	9	10	170
17780	....	...	...	...	....	....	...	....	8	28	116

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
1–4	1.15	39.6	15.5	12.8
12–15	1.13	36.9	20.2	12.4
21–24	1.33	39.8	9.6	6.1
28–31	1.32	38.3	5.7	2.7
38–41	1.76	29.8	6.3	2.1

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 20 — Saybrook silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay <2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture 1/3 atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%		%	%		%	%
48 Ill-99-4-1	0–14	A_1	(Not determined)		9.5	11.2	48.7	30.6	7.6	2.4	(Not determined)	2.01	(Not determined)	
48 Ill-99-4-2	14–19	A–B			9.0	17.2	38.4	35.4	7.1	1.0		1.53		
48 Ill-99-4-3	19–30	B_2			14.4	8.9	39.8	36.9	6.7	.6		1.43		
48 Ill-99-4-4	30+	C			22.6	11.1	51.8	14.5	8.1	.9		4.64		

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K	Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre			in.		%	%	in./hr.
48 Ill-99-4-1	16.1	8.0	.2	(Not determined)	27.1	(Not determined)	90	(Not determined)				(Not determined)				
48 Ill-99-4-2	12.1	7.9	.3		24.6		83									
48 Ill-99-4-3	9.7	6.8	.2		21.4		78									
48 Ill-99-4-4	20.9	4.5	.1		25.5		100									

Profile No. 21 — Elliott silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture 1/3 atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17476	0–5	A_1	.1	99.9	8.8	22.3	35.1	12.6	12.9	6.2	4.31	(Not determined)	5.40	29.1	14.3
17477	5–10	A_1	.1	99.9	8.5	20.4	38.7	12.9	14.1	5.8	3.28		6.25	27.7	12.5
17478	10–14	A_3	.2	99.8	7.9	19.1	39.0	16.7	13.7	5.8	2.08		6.43	25.4	13.0
17479	14–19	B_2	.4	99.6	8.3	14.2	37.1	16.1	21.8	5.9	1.33		4.23	26.0	14.9
17480	19–24	B_2	1.2	98.8	9.4	10.1	34.9	18.8	25.5	6.5	.88		2.94	27.1	16.8
17481	24–29	B_3	.5	99.5	10.5	10.5	34.4	20.4	23.7	7.0	.93		2.81	26.8	16.7
17482	29–35	C	5.5	94.5	10.3	8.3	29.4	15.3	17.9	7.8	.60		....	22.2	12.9
17483	35–41	C	8.9	91.1	9.8	8.3	28.5	13.9	16.6	7.9	.53		....	21.5	12.1
17484	41–48+	C	7.8	92.2	8.5	4.0	27.2	12.6	16.5	7.9	.57		....	21.6	11.9
17482[a]					14.9	13.9	39.6	19.0	12.4						
17483[a]					15.1	14.6	40.9	18.5	10.9						
17484[a]					15.7	14.8	41.5	18.1	10.5						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K	Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre			in.		%	%	in./hr.
17476	17.4	3.2	1.23	.30	22.2	24.2	92	94.9	38	188	300+	0–3	1.13	42.8	11.7	11.2
17477	16.0	2.6	.66	.18	19.4	22.2	87	82.2	19	90	300+	5–8	1.24	39.6	10.8	6.3
17478	14.6	2.3	.59	.15	17.6	20.2	87	66.4	15	32	300+	10–13	1.26	39.7	10.2	5.0
17479	13.4	3.2	.60	.15	17.3	19.6	88	51.7	10	16	300+	14½–17½	1.44	39.2	9.7	7.4
17480	12.9	4.4	.62	.17	18.1	18.6	97	42.0	7	9	300+	19½–22½	1.45	38.2	9.8	6.3
17481	12.8	4.6	.51	.14	18.0	18.4	98	41.7	7	70	300+	24½–27½	1.46	39.7	7.3	1.5
17482	....	...	...	...	....	....	..	....	4	120	235	29–32	1.66	34.5	6.5	.8
17483	....	...	...	...	....	....	..	....	3	40	146	35–38	1.65	34.5	5.3	.5
17484	....	...	...	...	....	....	..	....	4	26	134	41–44	1.66	35.1	5.0	.5

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 22 — Elliott silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17504	0–7	A_{11}	.2	99.8	11.9	12.1	35.3	15.4	16.7	5.9	4.15	....	3.29	30.9	15.5
17505	7–12	A_{12}	.8	99.2	12.2	12.5	36.0	16.5	17.5	6.1	2.83	....	2.64	26.4	14.1
17506	12–16	B_1	2.4	97.6	11.3	10.7	35.7	17.9	21.5	6.4	1.50	....	2.14	24.7	14.8
17507	16–21	B_{21}	.8	99.2	9.6	7.2	30.6	21.1	28.7	6.7	.88	....	1.78	27.2	17.1
17508	21–24	B_{22}	1.0	99.0	10.5	8.8	33.3	21.9	24.9	7.2	.68	....	1.67	26.8	16.4
17509	24–31	C	1.3	98.7	9.4	8.3	27.9	20.1	18.9	7.7	.53	19.4	....	25.4	14.8
17510	31–38	C	2.5	97.5	9.9	7.2	28.7	20.2	13.5	7.7	.46	25.3	....	22.6	13.4
17511	38–43+	C	5.9	94.1	10.2	6.5	28.4	19.5	11.6	7.9	.47	29.7	....	22.6	13.3
17509[a]					11.9	9.6	39.1	25.8	13.1						
17510[a]					12.4	10.4	42.0	24.3	10.7						
17511[a]					13.3	10.1	41.0	24.4	10.5						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
17504	17.3	5.3	.41	.26	23.2	28.6	81	89.1	23	26	276
17505	15.0	5.7	.30	.22	21.2	22.0	96	64.7	13	13	200
17506	13.5	6.3	.32	.25	20.4	18.8	100+	47.7	11	11	170
17507	14.2	8.0	.35	.27	22.8	18.6	100+	37.3	13	30	158
17508	12.5	7.5	.27	.25	20.5	14.8	100+	31.6	9	146	134
17509	....	...	...	...	....	....	...	....	7	96	122
17510	....	...	...	...	....	....	...	....	7	17	100
17511	....	...	...	...	....	....	...	....	7	7	134

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
0–3	1.12	50.2	5.9	2.57
7–10	1.26	43.1	6.0	2.36
12–15	1.42	38.7	6.5	2.33
16–19	1.47	42.4	4.1	.68
21–24	1.49	41.2	3.4	.06
24–27	1.57	38.8	2.5	.09

Profile No. 23 — Elliott silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay <2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	15 atm.
	in.		%	%	%	%	%	%		%	%		%	%
48 Ill-99-1-1	0–12	A_1	(Not determined)		22.4	15.4	33.8	28.4	6.6	2.4	(Not determined)	2.42	(Not determined)	
48 Ill-99-1-2	12–18	A–B			20.2	15.2	36.6	28.0	5.1	.8		2.28		
48 Ill-99-1-3	18–24	B_{21}			23.6	9.6	27.8	39.0	5.2	.5		1.82		
48 Ill-99-1-4	24–36	B_{22}			23.3	8.2	28.7	39.8	6.5	.2		1.78		
48 Ill-99-1-5	36+	C			23.3	10.9	37.0	28.2	8.1	.1		3.82		

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
48 Ill-99-1-1	13.1	5.4	.3	(Not determined)	24.7	(Not determined)	76	(Not determined)			
48 Ill-99-1-2	6.6	2.9	.2		15.8		61				
48 Ill-99-1-3	8.9	4.9	.2		21.3		66				
48 Ill-99-1-4	10.3	5.8	.2		20.5		80				
48 Ill-99-1-5	24.1	6.3	.1		30.5		100				

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
(Not determined)				

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 24 — Swygert silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17790	0–8	A_{11}	.3	99.7	5.0	18.2	36.6	13.3	18.4	6.3	3.37	....	2.00	32.1	16.9
17791	8–11	A_{12}	.2	99.8	5.0	17.7	38.1	13.7	19.4	6.1	2.56	....	1.80	29.6	15.0
17792	11–14	B_1	.8	99.2	5.2	17.1	37.4	14.5	21.1	6.2	1.98	....	1.56	28.7	15.2
17793	14–18	B_{21}	1.0	99.0	4.9	13.3	34.1	16.7	27.1	5.9	1.39	....	1.29	28.7	16.7
17794	18–23	B_{22}	.8	99.2	6.1	8.6	33.6	20.0	29.4	6.4	1.06	....	1.29	28.1	17.5
17795	23–27	B_{23}	.9	99.1	6.5	7.6	32.6	19.0	26.7	7.1	1.00	....	1.36	27.5	17.5
17796	27–31	C_1	1.9	98.1	6.3	7.1	30.2	17.3	22.6	7.8	....	18.1	....	26.0	16.0
17797	31–40+	C_2	.7	99.3	5.9	6.3	26.5	16.6	17.8	8.0	....	26.0	....	22.4	13.7
17796[a]					8.5	8.3	37.9	24.2	20.3						
17797[a]					11.6	9.9	39.9	23.1	14.5						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17790	15.6	7.8	.47	.19	24.1	27.6	87	87.1	10	16	300
17791	13.0	7.2	.36	.20	20.8	24.7	84	74.6	10	16	235
17792	12.6	8.1	.37	.30	21.3	24.1	88	67.7	9	10	235
17793	12.4	9.6	.40	.32	22.7	25.3	90	57.8	9	10	217
17794	11.6	9.0	.39	.36	21.4	20.8	100+	42.1	8	9	200
17795	11.0	8.1	.31	.38	19.8	17.2	100+	37.6	8	61	170
17796	....	...	...	...	....	....	...	....	8	110	158
17797	....	...	...	...	....	....	...	....	8	32	146

Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
0–3	1.11	42.9	16.5	....
7–10	1.21	42.5	14.0	....
17–20	1.42	38.6	7.3	....

Profile No. 25 — Swygert silt loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay <2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%		%	%		%	%
48 Ill-99-3-1	0–9	A_1	(Not		12.3	15.3	40.3	32.1	6.0	2.9	(Not	2.85	(Not	
48 Ill-99-3-2	9–12	A–B	determined)		14.0	13.0	38.2	34.8	5.6	1.2	deter-	2.23	determined)	
48 Ill-99-3-3	12–26	B_2			10.9	8.8	32.7	48.0	7.5	.1	mined)	1.13		
48 Ill-99-3-4	26+	C			13.4	10.4	38.0	38.2	8.1	.1		3.10		

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
48 Ill-99-3-1	11.1	3.9	.6	(Not	23.9	(Not	65	(Not determined)			
48 Ill-99-3-2	7.8	3.5	.1	deter-	19.3	deter-	59				
48 Ill-99-3-3	11.2	9.9	.1	mined)	22.4	mined)	95				
48 Ill-99-3-4	24.2	7.8	.1		32.1		100				

Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
	(Not determined)			

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 26 — Clarence silt loam to silty clay loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17740	0–5	A_1	1.2	98.8	3.4	21.7	33.7	12.6	20.4	6.5	3.96	....	1.68	33.4	16.5
17741	5–8	A_3	1.5	98.5	2.3	14.0	27.1	20.6	29.6	5.6	1.85	....	.80	29.8	17.4
17742	8–11	B_{21}	.2	99.8	1.6	6.7	21.1	24.0	43.8	6.0	1.36	....	.55	33.8	21.7
17743	11–15	B_{22}	.1	99.9	1.1	4.6	21.8	30.3	40.1	7.1	.91	....	.64	32.1	19.9
17744	15–24	C_1	.7	99.3	.7	4.6	18.6	28.4	32.8	7.8	.72	19.2	....	29.3	17.8
17745	24–50+	C_2	.4	99.6	.6	2.7	19.1	29.3	30.3	7.9	.75	20.4	....	34.8	18.3
17744[a]					1.6	4.2	26.0	42.0	25.2						
17745[a]					1.6	3.5	27.2	43.8	22.8						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17740	14.1	8.4	.88	.25	23.6	25.6	92	77.6	10	17	300+
17741	9.2	11.5	.55	.14	21.4	26.6	80	53.0	8	9	300+
17742	9.8	17.7	.53	.24	28.2	28.7	98	42.3	10	5	300
17743	9.9	15.4	.40	.34	26.1	22.6	100+	32.1	6	58	200
17744	....	...	...	...	....	....	...	....	5	120	170
17745	....	...	...	...	....	....	...	....	5	40	152

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
½–3½	1.00	45.7	13.7	8.8
8–11	1.34	46.7	4.4	.4
20–23	1.55	41.1	3.5	.2

Profile No. 27 — Clarence silt loam to silty clay loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay <2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%		%	%		%	%
48 Ill-99-5-1	0–11	A_1	(Not determined)		11.8	12.6	39.2	35.4	6.7	1.9	(Not determined)	1.96	(Not determined)	
48 Ill-99-5-2	11–16	A–B			9.9	8.8	31.8	49.7	6.8	.8		1.42		
48 Ill-99-5-3	16–29	B_2			8.0	6.2	28.6	57.2	7.2	.2		1.32		
48 Ill-99-5-4	29+	C			8.2	8.2	35.2	48.4	7.9	.1		2.71		

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
48 Ill-99-5-1	11.0	5.6	1.0	(Not determined)	22.3	(Not determined)	79	(Not determined)			
48 Ill-99-5-2	11.2	7.9	.8		24.6		81				
48 Ill-99-5-3	12.0	9.1	.5		24.7		87				
48 Ill-99-5-4	24.7	9.1	.2		34.0		100+				

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
(Not determined)				

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 28 — Drummer silty clay loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	CaCO3 equiv.	Ca/Mg	Moisture 1/3 atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
16543...........	0–2	A_1	(Not		21.7	19.8	22.6	8.8	14.8	7.7	5.52	(Not	2.07	33.9	18.0
16544...........	2–4	A_1	determined)		23.7	20.3	22.6	7.5	15.9	7.1	4.95	deter-	2.00	30.5	17.3
16545...........	4–6	A_1			25.5	18.8	23.0	7.8	15.9	7.1	4.24	mined)	2.37	29.1	16.6
16546...........	6–8	A_1			25.1	19.7	22.9	7.8	16.3	7.0	2.94		1.90	25.9	14.5
16547...........	8–10	A_1			25.2	20.4	23.6	8.2	16.7	6.9	2.03		2.94	24.3	13.2
16548...........	10–12	A_3–B_1			24.2	20.9	24.6	8.8	17.3	6.9	1.51		....	23.1	12.4
16549...........	12–15	B_{21}			20.8	19.9	29.2	5.9	20.6	7.2	1.02		2.73	23.8	11.4
16551...........	18–21	B_{22}			11.0	24.5	29.1	10.6	22.5	7.2	.54		2.48	27.9	14.1
16553...........	24–27	B_{22}			16.9	31.5	24.1	8.2	17.6	7.5	.29		2.23	23.7	11.9
16555...........	30–34	B_3			25.8	31.9	20.0	8.2	12.7	8.0	.25		....	20.1	8.8
16557...........	38–43	C_1			58.1	13.3	11.1	4.0	6.2	8.3	.24		....	12.1	4.9
16560...........	50–60	C_2			38.5	9.5	14.0	4.3	6.6	8.4	.53		....	15.4	6.8
16560[a]..........					52.7	13.3	20.9	8.8	3.9						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
16543..........	24.2	11.7	.44	.18	36.5	33.9	100+	143.6	28	64	300+
16544..........	22.8	11.4	.23	.21	34.7	33.5	100+	143.2	24	50	217
16545..........	21.8	9.2	.23	.21	31.5	30.7	100+	130.0	21	44	200
16546..........	18.2	9.6	.21	.16	28.2	26.7	100+	110.8	17	42	170
16547..........	18.2	6.2	.22	.17	24.8	23.3	100+	93.6	13	21	146
16548..........	....	...	.19	.12	....	....	.....	....	13	30	140
16549..........	15.0	5.5	.23	.15	20.8	19.5	100+	73.6	11	28	134
16551..........	17.1	6.9	.28	.18	24.5	22.8	100+	68.9	9	78	134
16553..........	13.4	6.0	.25	.15	20.0	16.7	100+	64.7	7	200+	158
16555..........	....	...	...	...	....	....	.....	....	7	200+	122
16557..........	....	...	...	...	....	....	.....	....	9	194	110
16560..........	....	...	...	...	....	....	.....	....	7	18	72

Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
1½–4½	1.09	(Not determined)		
5–8	1.18			
9–12	1.39			
12–15	1.50			
15–18	1.48			
18–21	1.56			
24–27	1.64			
30–33	1.70			
48–51	1.60			

Profile No. 29 — Drummer silty clay loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	CaCO3 equiv.	Ca/Mg	Moisture 1/3 atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
17781...........	0–9	A_{11}	.5	99.5	7.3	20.1	31.3	9.0	22.3	7.4	4.80	....	1.18	34.7	20.6
17782...........	9–16	A_{12}	.9	99.1	5.0	19.5	34.6	7.6	27.5	6.8	2.46	....	1.04	31.1	18.8
17783...........	16–21	B_1	1.4	98.6	5.5	20.3	36.5	8.5	27.1	7.3	1.63	....	1.72	28.9	16.5
17784...........	21–25	B_{21}	1.3	98.7	5.4	20.2	36.1	10.3	25.5	7.5	1.12	....	1.64	28.4	16.1
17785...........	25–29	B_{22}	.8	99.2	4.9	20.7	37.5	10.6	25.1	7.5	.80	....	1.53	29.1	16.0
17786...........	29–35	B_3	1.0	99.0	5.1	20.3	37.4	11.5	23.9	7.1	.60	....	1.36	29.5	16.0
17787...........	35–50	C_1	1.4	98.6	6.0	20.8	37.4	10.6	23.4	7.4	....	....	1.48	28.1	15.3
17788...........	50–54	C_{21}	26.3	73.7	56.6	9.9	14.3	5.3	9.8	7.7	....	15.7	14.14	16.3	8.0
17789...........	60–65+	D	1.1	98.9	20.6	10.9	28.6	11.5	11.9	7.6	....	18.5	....	21.3	10.8
17789[a]..........					26.7	13.3	33.0	14.4	11.5						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
17781..........	21.6	18.3	.70	.26	40.9	39.8	100+	127.2	20	51	300+
17782..........	17.4	16.7	.45	.27	34.8	35.8	97	102.0	12	38	217
17783..........	18.8	10.9	.41	.22	30.3	29.6	100+	83.1	11	54	170
17784..........	17.2	10.5	.35	.22	28.2	27.2	100+	76.0	10	89	146
17785..........	16.2	10.6	.36	.26	27.4	25.9	100+	72.5	8	126	146
17786..........	16.0	11.8	.36	.25	28.5	25.7	100+	72.6	9	177	170
17787..........	14.4	9.7	.41	.27	24.8	22.6	100+	66.5	10	200+	235
17788..........	9.9	.7	.20	.19	11.0	8.8	100+	58.3	14	200+	170
17789..........	....	...	...	...	....	....	.....	....	10	164	122

Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
1–4	0.98	40.3	22.3	13.5
13–16	1.35	39.7	11.8	5.7
25–28	1.43	38.7	7.8	6.1
35–38	1.44	41.0	5.0	2.0
52–55	1.46	41.0	5.4	.2

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 30 — Ashkum silty clay loam

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	<2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
16490	0–2	A_1	(Not determined)		16.9	12.6	32.2	10.3	15.3	6.0	4.77	....	2.34	29.6	18.4
16491	2–4	A_1			15.8	13.1	31.7	12.1	18.6	5.9	4.10	....	2.43	31.4	17.2
16492	4–6	A_1			16.0	12.9	32.3	12.1	19.6	6.4	3.45	....	2.21	31.3	16.6
16493	6–8	A_1			15.8	12.7	32.4	13.3	19.1	6.3	2.98	....	1.98	29.4	16.3
16494	8–10	A_1			15.1	12.4	34.9	13.5	19.9	6.4	2.52	....	1.98	27.0	15.6
16495	10–12	A_3–B_1			16.3	11.9	34.5	11.2	17.9	6.4	1.98	....	1.81	25.0	14.5
16496	12–15	A_3–B_1			13.7	12.5	36.4	13.6	21.4	7.0	1.94	....	1.86	26.0	14.2
16498	18–21	B_{22}			15.3	11.5	37.6	15.0	15.7	7.3	.70	....	1.84	25.1	14.3
16500	24–27	B_3			9.2	8.8	38.2	15.5	13.7	7.8	.54	9.7	1.55	23.8	13.9
16502	30–34	C			8.0	8.3	36.0	13.8	14.5	8.0	.46	17.4	....	23.0	13.3
16504	38–44	C			7.6	7.7	34.7	13.7	11.6	8.3	.42	21.4	....	23.0	12.2
16506	50–58+	C			6.8	8.1	36.7	16.9	12.4	8.2	.46	23.0	....	22.9	11.8
16500[a]					12.9	10.7	41.0	18.4	16.1						
16502[a]					13.1	11.2	44.0	17.6	13.7						
16504[a]					12.0	11.4	47.5	18.4	10.9						
16506[a]					11.2	11.3	48.5	17.5	11.4						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
16490	17.1	7.3	.98	.19	25.6	28.6	89	112.2	26	38	300+
16491	17.5	7.2	.62	.17	25.5	27.8	92	90.6	19	21	300+
16492	18.1	8.2	.36	.19	26.9	27.7	97	87.4	19	32	288
16493	17.0	8.6	.31	.19	26.1	26.4	99	81.5	15	20	244
16494	16.4	8.3	.31	.20	25.2	25.0	100+	74.8	11	13	235
16495	15.0	8.3	.29	.18	23.8	23.0	100+	79.0	11	19	208
16496	14.5	7.8	.31	.15	22.8	21.5	100+	61.4	9	23	200
16498	14.5	7.9	.31	.19	22.9	19.6	100+	63.8	11	80	170
16500	13.3	8.6	.28	.17	22.3	14.7	100+	50.3	8	126	146
16502	....	...	...	...	....	....	.....	....	9	132	152
16504	....	...	...	...	....	....	.....	....	7	72	152
16506	....	...	...	...	....	....	.....	....	11	23	140

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
1½–4½	1.08	(Not determined)		
5–8	1.27			
9–12	1.38			
12–15	1.50			
15–18	1.57			
18–21	1.54			
24–27	1.56			
30–33	1.58			
48–51	1.75			

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 31 — Bryce silty clay

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample		Particle-size distribution: Based on <2 mm. fraction					pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture	
			>2 mm.	<2 mm.	Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ					1/3 atm.	15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
16473	0–2	A_1	(Not determined)		11.6	11.3	32.4	13.3	22.1	6.1	5.10	....	1.77	33.5	19.3
16474	2–4	A_1			11.8	9.8	31.6	13.0	24.4	6.3	3.99	....	1.94	32.7	18.7
16475	4–6	A_1			9.2	7.9	33.4	15.2	25.8	6.4	3.79	....	2.18	31.3	19.3
16476	6–8	A_1			8.5	9.1	32.5	14.9	28.0	6.4	3.12	....	1.94	30.7	19.3
16477	8–10	A_1			7.6	9.0	32.9	16.7	27.6	6.5	2.72	....	1.86	30.1	18.9
16478	10–12	A_1			7.2	11.4	31.7	12.9	29.5	6.6	2.23	....	1.87	30.9	18.2
16479	12–15	B_1			7.6	9.0	34.3	17.4	28.4	6.8	1.66	....	1.59	30.5	17.7
16481	18–21	B_{21}			6.2	10.5	34.1	14.7	29.6	7.3	.86	....	1.52	29.3	17.2
16483	24–27	B_{23}			5.1	10.6	33.5	16.3	30.3	7.5	.54	....	1.57	29.2	17.6
16485	30–34	B_3			4.8	11.7	35.9	15.1	27.9	7.5	.37	....	1.65	29.5	17.2
16487	38–44	C_1			6.0	7.9	31.1	18.5	24.5	7.7	.38	....	1.45	26.5	16.9
16488	44–54	C_2			4.9	5.9	37.8	23.8	18.4	7.9	.37	19.3	....	25.8	16.3
16489	54–58+	C_2			4.2	6.1	28.8	17.5	19.8	8.0	.52	24.3	....	27.6	15.6
16487[a]					8.0	7.6	38.1	25.4	20.4						
16488[a]					7.7	7.8	41.5	25.3	17.5						
16489[a]					8.0	7.0	42.9	25.4	16.0						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
16473	19.1	10.8	.65	.19	30.7	32.6	94	92.1	19	34	300+
16474	20.6	10.6	.52	.19	32.0	32.8	97	87.7	17	26	300+
16475	21.4	9.8	.49	.20	31.9	33.1	96	80.7	11	21	265
16476	21.2	10.9	.38	.20	32.6	32.6	100	76.0	15	34	254
16477	20.6	11.1	.38	.23	32.3	31.2	100+	70.4	12	26	217
16478	20.4	10.9	.39	.25	31.9	29.6	100+	69.8	11	19	200
16479	18.6	11.7	.36	.24	30.9	27.7	100+	60.5	8	26	170
16481	17.3	11.4	.28	.32	29.3	24.0	100+	54.0	9	34	158
16483	17.1	10.9	.26	.31	28.5	22.8	100+	48.9	9	54	122
16485	16.7	10.1	.26	.30	27.4	21.3	100+	49.5	9	111	128
16487	15.1	10.4	.19	.21	25.9	14.1	100+	....	6	129	140
16488	....	...	...	...	....	....	.....	....	5	108	146
16489	....	...	...	...	....	....	.....	....	7	34	146

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
1½–4½	1.18	(Not determined)		
5–8	1.35			
9–12	1.48			
12–15	1.48			
15–18	1.51			
18–21	1.54			
24–27	1.57			
30–33	1.59			
48–51	1.75			

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 32 — Bryce silty clay

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture 1/3 atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
16525	0–2	A_1	(Not determined)		3.2	7.7	31.3	20.7	25.5	6.2	6.01	....	1.88	40.6	....
16526	2–4	A_1			2.9	8.0	32.6	19.8	28.1	6.5	4.07	....	1.50	36.6	21.4
16527	4–6	A_1			2.8	8.2	32.0	21.8	28.7	6.5	3.25	....	1.58	32.8	19.5
16528	6–8	A_1			3.3	9.1	32.8	20.6	30.0	6.9	2.31	....	1.26	30.5	17.9
16529	8–10	A_1			3.3	8.3	35.3	21.8	29.2	7.6	1.76	....	1.16	29.5	17.1
16530	10–12	A_3			3.5	8.7	33.6	17.7	28.5	7.9	1.39	....	1.22	28.4	16.1
16531	12–15	B_{21}			3.4	13.4	30.0	23.6	28.8	8.0	1.12	12.4	1.26	27.6	16.0
16533	18–21	B_3			2.7	8.2	33.3	19.9	29.0	8.4	.56	....	....	27.7	15.8
16535	24–27	C			2.9	7.4	31.3	21.6	29.3	8.2	.49	....	....	29.3	16.8
16537	30–34	C			2.5	4.3	29.0	22.2	24.9	8.4	.46	....	....	27.3	16.4
16539	38–44	C			2.3	3.8	27.7	18.5	25.3	8.3	.51	25.6	....	27.0	16.3
16541	53–60+	C			2.5	2.9	30.2	27.6	20.2	8.6	.58	24.4	....	27.6	16.1
16533[a]					5.3	8.2	35.2	27.2	24.1						
16535[a]					4.5	8.5	35.6	29.3	23.1						
16537[a]					4.5	5.4	39.7	32.1	18.7						
16539[a]					4.5	6.0	41.1	32.2	16.4						
16541[a]					4.8	5.9	40.5	31.9	16.1						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	*meq./100 gm. clay*	*lb. per acre*		
16525	21.8	11.6	.95	.20	34.6	36.6	95	79.2	28	60	300+
16526	20.6	13.7	.85	.28	35.4	36.2	98	75.6	21	56	300+
16527	20.2	12.8	.67	.19	33.9	33.8	100+	66.9	15	46	300+
16528	18.1	14.4	.55	.23	33.3	29.8	100+	58.9	11	34	254
16529	16.9	14.5	.44	.26	32.1	27.0	100+	52.9	19	46	200
16530	16.7	13.7	.42	.30	31.1	25.2	100+	54.5	9	46	164
16531	16.6	13.2	.39	.32	30.5	23.8	100+	45.4	9	36	158
16533	....	....	...	...	....	....	.....	....	9	19	134
16535	....	....	...	...	....	....	.....	....	7	82	146
16537	....	....	...	...	....	....	.....	....	9	24	152
16539	....	....	...	...	....	....	.....	....	7	17	152
16541	....	....	...	...	....	....	.....	....	7	42	184

Core sample data: Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	*in./hr.*
	(Not determined)			

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

Profile No. 33 — Rowe silty clay loam to silty clay

Lab. No.	Depth	Horizon	Particle-size distribution: Based on entire sample >2 mm.	Based on entire sample <2 mm.	Based on <2 mm. fraction: Sand 2.0-.05 mm.	Silt 50-20μ	Silt 20-2μ	Clay 2-.2μ	Clay <.2μ	pH	Org. carb.	$CaCO_3$ equiv.	Ca/Mg	Moisture ⅓ atm.	Moisture 15 atm.
	in.		%	%	%	%	%	%	%		%	%		%	%
16455	0–2	A_1	(Not determined)		3.4	6.9	39.0	20.3	20.1	6.1	5.55	(Not determined)	1.88	37.0	20.6
16456	2–4	A_1			3.9	9.7	37.7	19.5	22.2	6.1	4.00		1.80	34.5	19.3
16457	4–6	A_1			4.2	9.0	36.8	21.0	22.0	6.1	3.44		1.58	32.3	19.6
16458	6–8	A_1			5.0	8.8	34.7	20.4	26.7	6.1	2.23		1.22	30.3	18.0
16459	8–10	A_3			4.0	8.4	26.0	26.0	32.1	6.0	1.63		1.02	31.6	19.2
16460	10–12	B_1			3.9	7.4	29.2	20.2	35.9	5.8	1.31		.90	33.3	20.2
16461	12–15	B_{21}			3.4	7.7	26.5	24.5	36.9	6.1	1.14		.82	33.7	20.9
16463	18–21	B_{22}			3.4	7.9	26.9	21.2	37.2	5.6	.85		.68	32.9	20.8
16465	24–27	B_{22}			3.8	8.6	29.0	22.1	35.5	5.6	.78		.63	32.5	20.6
16467	30–34	B_3			4.1	9.6	29.8	21.6	32.6	5.9	.54		.58	31.0	19.1
16469	38–44	C_1			4.4	7.3	31.2	21.8	30.3	6.8	.48		.53	30.0	18.5
16471	53–57+	C_2			3.0	3.6	29.1	23.6	23.0	7.3	.45		....	30.0	17.8
16471[a]					5.2	5.7	38.3	32.3	18.7						

Lab. No.	Ex. Ca	Ex. Mg	Ex. K	Ex. Na	Total ex. bases	Cat. ex. cap.	Base sat.	Cat. ex. cap.[b]	P_1	P_2	K
	meq. per 100 gm. soil <2 mm.						%	meq./100 gm. clay	lb. per acre		
16455	18.6	9.9	.84	.14	29.5	32.1	92	79.4	26	50	300+
16456	17.8	9.9	.68	.15	28.5	30.2	94	72.4	34	38	300+
16457	16.1	10.2	.56	.16	27.1	28.8	94	67.0	21	24	300+
16458	14.1	11.6	.48	.18	26.4	26.8	98	56.9	15	17	288
16459	13.7	13.4	.53	.22	27.8	28.6	97	49.2	15	17	300
16460	12.8	14.2	.53	.26	27.9	28.3	98	50.4	11	14	300
16461	12.1	14.8	.57	.29	27.8	28.4	98	46.2	12	13	300+
16463	10.3	15.2	.56	.41	26.5	26.5	100	45.4	9	11	300+
16465	9.5	15.1	.56	.55	25.7	25.5	100+	44.3	10	11	288
16467	8.8	15.3	.44	.70	25.2	22.8	100+	42.1	9	9	217
16469	7.5	14.1	.27	1.09	23.0	18.1	100+	34.7	8	132	146
16471	....	....	...	...	....	....	.....	....	8	176	300+

Core sample data

Depth	Bulk dens.	Cap. pores	Non-cap. pores	Hydr. cond.
in.		%	%	in./hr.
1½–4½	1.22	(Not determined)		
5–8	1.38			
9–12	1.50			
12–15	1.52			
15–18	1.55			
18–21	1.55			
24–27	1.58			
30–33	1.63			
48–51	1.69			

[a] Sodium hexametaphosphate used as dispersing agent; carbonates *not* removed.
[b] Not corrected for organic matter.

APPENDIX D: HEAVY-MINERAL DATA

Content of Heavy Minerals (>2.87 Specific Gravity) in Various Sand Fractions and in the Coarse Silt Fraction

Profile number and soil series	Horizon	Lab. No.	Sands: Very coarse (2-1 mm.)[a]	Sands: Coarse (1-0.5 mm.)	Sands: Medium (0.5-0.25 mm.)	Sands: Fine (0.25-0.1 mm.)	Sands: Very fine (0.1-0.05 mm.)	Coarse silt (50-20 μ)
			perct.	*perct.*	*perct.*	*perct.*	*perct.*	*perct.*
Gray-Brown Podzolic soils								
No. 1, Fox	A_1	17746	(b)	3.43	2.01	4.02	2.93	2.72
	A_2	17747	10.58	2.26	1.61	2.92	1.84	2.50
	B_2	17750	12.47	8.21	4.07	4.85	2.87	2.87
	C_2	17753	20.94	16.28	10.45	15.17	5.54	3.93
No. 4, McHenry	A_1	17768	7.26	3.33	1.18	2.35	3.25	2.96
	A_2	17769	5.76	2.15	.97	1.95	2.89	3.35
	B_{22}	17772	7.53	2.24	1.87	2.74	6.16	5.85
	C	17774	6.53	3.03	1.49	2.24	2.89	4.67
No. 6, Miami	A_1	17731	4.12	2.40	1.31	2.02	2.04	(b)
	A_{22}	17733	4.78	2.17	1.01	2.07	2.46	(b)
	B_2	17736	(b)	2.43	1.45	2.23	3.54	(b)
	C_2	17739	5.29	3.77	2.19	2.55	3.84	(b)
No. 9, Blount	A_p	17520	0	1.33	.84	1.33	2.60	1.62
	A_2	17521	2.15	2.40	1.02	2.17	3.14	2.11
	B_{22}	17524	.47	.98	.64	1.07	1.77	1.52
	C_2	17527	3.01	2.18	1.01	1.54	2.21	(b)
No. 10, Eylar	A_{11}	17760	5.87	2.08	.98	1.17	2.25	2.53
	A_2	17762	3.16	1.61	.85	1.15	1.74	1.79
	B_2	17764	.32	1.33	.73	1.03	2.21	1.93
	C_2	17767	8.72	7.23	2.86	1.67	2.42	4.09
No. 11, Eylar	A_1	17754	(b)	4.56	3.67	2.85	2.24	3.23
	A_2	17755	0	2.28	1.32	1.84	2.29	2.77
	B_2	17757	6.61	2.27	1.15	1.82	2.30	2.09
	C_2	17759	5.64	8.65	4.46	2.85	1.73	7.29
Gray-Brown Podzolic intergrade to Brunizem soils								
No. 13, Beecher	A_p	17512	2.66	1.27	.66	1.33	2.34	1.70
	A_2	17513	.82	1.20	.85	1.36	2.38	1.45
	B_{22}	17516	3.90	.71	.51	1.20	2.12	1.28
	C_2	17519	9.68	7.32	5.96	1.74	2.18	1.56

Content of Heavy Minerals (concluded)

				Brunizem soils				
No. 16, Warsaw	A_1	17612	10.30	3.27	3.07	4.76	3.78	3.05
	B_2	17616	8.26	3.08	1.68	3.08	3.47	3.56
	C	17618	10.45[c]	6.50[c]	5.41[c]	13.92[c]	10.23[c]	7.06[c]
No. 17, Ringwood	A_1	17595	7.84	1.70	.92	1.64	3.42	2.77
	B_2	17599	3.29	2.86	1.24	1.71	3.58	3.24
	C	17602	13.36	2.95	1.28	2.18	3.69	3.57
No. 19, Saybrook	A_1	17775	12.96	1.81	.81	1.68	3.47	1.19
	B_2	17778	0	2.37	.64	1.34	4.73	2.14
	C	17780	11.34	1.83	.95	1.75	([b])	1.29
No. 22, Elliott	A_{11}	17504	1.63	1.79	2.66[c]	1.42	2.58	1.91
	B_{22}	17508	1.61	1.90	.72	1.27	2.43	1.51
	C	17511	.58	.85	.73	1.29	2.50	1.12
No. 24, Swygert	A_{11}	17790	0	.56	.58	1.06	1.25	.86
	B_{22}	17794	0	.10	.31	.95	1.55	.62
	C_2	17797	1.29	.86	.48	1.09	1.95	.75
No. 26, Clarence	A_1	17740	8.91[c]	4.55[c]	4.29[c]	4.78[c]	1.96[c]	1.79
	B_{22}	17743	0	5.15	3.64	3.76	3.53	2.09
	C_2	17745	0	1.10[c]	2.73	1.97	3.67	2.33
				Humic-Gley soils				
No. 28, Drummer	A_1	16543	7.53	4.38	1.37	2.07	2.67	2.11
	B_{22}	16553	0	3.63	1.50	1.92	1.64	2.43
	C_2	16560	5.68	2.87	1.97	3.38	5.04	3.18
No. 29, Drummer	A_{11}	17781	([b])	3.52	1.65	2.93	8.37	1.97
	B_{21}	17784	3.17	.98	.83	2.84	2.62	1.31
	D	17789	3.09	.93	.64	1.32	2.17	.76
No. 30, Ashkum	A_1	16490	1.56	1.85	1.10	1.78	3.67	1.40
	A_3-B_1	16496	.15	2.62	1.26	2.01	4.06	([b])
	C	16506	1.32	1.34	.63	1.09	2.01	([b])
No. 31, Bryce	A_1	16473	3.74	2.07	1.33	.83	2.34	2.81
	B_1	16479	.62	1.56	.74	.89	2.44	([b])
	C_2	16488	1.25	1.42	.93	.99	2.07	1.58
No. 33, Rowe	A_1	16455	4.76	([b])	([b])	1.77	2.33	2.43
	B_{21}	16461	0	3.60[c]	1.35[c]	1.04	2.49	2.06
	C_2	16471	.51	1.16	.42	1.02	2.07	2.02

[a] Many coarse sand grains are composed of two or more minerals; therefore, many of the percentages shown here are too high or too low.
[b] Heavy-mineral fraction was not determined.
[c] These data are single determinations only; the rest are averages of two or more.

Relative Frequency of Heavy Minerals (>2.87 Specific Gravity) in the Very Fine Sand Fraction (0.1–0.05 mm.)[a]

Profile number and soil series	Horizon	Lab. No.	Opaques	Ferromagnesium[b]	Epidote-zoisite	Garnet	Tourmaline	Zircon	Accessories[c]	Grains counted: Identified	Unknown	Total
Gray-Brown Podzolic soils												
No. 1, Fox	A_1	17746	VC	A	VC	FC	S	R	S	550	60	610
	A_2	17747	FA	FA	VC	FC	S	R	FC	522	46	568
	B_2	17750	VC	A	VC	FC	R	R	S	537	136	673
	C_2	17753	VC	VA	C	R	0	R	R	542	122	664
No. 4, McHenry	A_1	17768	FA	A	VC	C	R	S	R	528	60	588
	A_2	17769	A	FA	VC	C	R	S	R	548	39	587
	B_{22}	17772	FA	A	C	FC	R	S	FC	531	59	590
	C	17774	A	FA	VC	C	R	R	S	510	73	583
No. 6, Miami	A_1	17731	VC	A	FA	FC	R	R	C	542	66	608
	A_{22}	17733	C	A	FA	C	R	S	R	505	35	540
	B_2	17736	VC	A	VC	VC	0	R	C	526	41	567
	C_2	17739	C	A	VC	C	R	S	C	521	68	589
No. 9, Blount	A_p	17520	C	A	FA	C	R	S	R	529	27	556
	A_2	17521	VC	A	VC	C	0	S	R	524	27	551
	B_{22}	17524	VC	A	VC	C	R	R	C	536	86	622
	C_2	17527	C	A	VC	FC	R	0	C	487	81	568
No. 10, Eylar	A_{11}	17760	FA	A	VC	FC	R	R	S	459	48	507
	A_2	17762	FA	A	VC	S	S	R	R	543	53	596
	B_2	17764	FA	A	VC	FC	R	R	S	534	60	594
	C_2	17767	VC	A	VC	C	R	R	S	561	87	648
No. 11, Eylar	A_1	17754	FA	FA	VC	S	R	0	FC	511	197	708
	A_2	17755	FA	A	VC	FC	R	R	S	543	51	594
	B_2	17757	FA	A	C	FC	R	R	S	511	61	572
	C_2	17759	VC	VA	FC	S	R	R	R	511	38	549
Gray-Brown Podzolic intergrade to Brunizem soils												
No. 13, Beecher	A_p	17512	VC	A	VC	FC	R	R	S	510	45	555
	A_2	17513	VC	A	VC	FC	R	0	S	542	67	609
	B_{22}	17516	VC	A	VC	FC	R	R	S	540	61	601
	C_2	17519	VC	A	VC	C	R	R	S	532	64	596
Brunizem soils												
No. 16, Warsaw	A_1	17612	C	VA	VC	FC	R	R	S	481	52	533
	B_2	17616	VC	A	VC	FC	R	R	R	509	58	567
	C	17618	C	VA	FC	S	R	R	S	521	57	578

Relative Frequency of Heavy Minerals (concluded)

No. 17, Ringwood	A_1	17595	VC	A	VC	FC	R	R	R	467	70	537
	B_2	17599	VC	A	C	C	R	S	R	520	76	596
	C	17602	VC	VA	C	FC	R	R	S	546	78	624
No. 19, Saybrook	A_1	17775	VC	A	VC	C	0	S	R	523	108	631
	B_2	17778	A	A	VC	C	R	0	FC	514	66	580
	C	17780	VC	A	VC	C	R	S	S	560	88	648
No. 22, Elliott	A_{11}	17504	VC	A	VC	C	R	S	FC	478	54	532
	B_{22}	17508	C	A	FA	C	0	R	FC	504	55	559
	C	17511	VC	VA	VC	FC	R	FC	S	507	42	549
No. 24, Swygert	A_{11}	17790	VC	A	FA	FC	0	S	S	490	56	546
	B_{22}	17794	VC	A	VC	C	R	R	FC	498	53	551
	C_2	17797	VC	A	VC	C	R	R	C	528	52	580
No. 26, Clarence	A_1	17740	FA	A	VC	S	0	R	R	507	76	583
	B_{22}	17743	VC	VA	C	S	0	R	FC	508	49	557
	C_2	17745	VC	A	VC	FC	R	R	0	511	135	646
					Humic-Gley soils							
No. 28, Drummer	A_1	16543	C	A	VC	C	R	0	FC	543	58	601
	B_{22}	16553	C	A	VC	FC	R	0	S	538	74	612
	C_2	16560	C	A	VC	C	R	R	R	517	113	630
No. 29, Drummer	A_{11}	17781	VC	A	VC	FC	R	R	S	526	82	608
	B_{21}	17784	FC	A	VC	C	R	R	FC	524	41	565
	D	17789	VC	A	VC	C	R	S	FC	519	31	550
No. 30, Ashkum	A_1	16490	VC	A	VC	VC	R	R	S	519	56	575
	A_3-B_1	16496	VC	A	VC	VC	R	FC	S	550	39	589
	C	16506	VC	A	VC	C	S	S	S	530	61	591
No. 31, Bryce	A_1	16473	VC	A	VC	C	R	R	FC	512	66	578
	B_1	16479	VC	A	VC	VC	R	R	FC	532	39	571
	C_2	16488	VC	A	VC	C	R	FC	FC	523	75	598
No. 33 Rowe	A_1	16455	VC	A	VC	C	R	R	S	544	124	668
	B_{21}	16461	VC	A	VC	C	R	R	S	502	105	607
	C_2	16471	VC	A	VC	C	R	S	FC	526	68	594

[a] The symbols used to report relative frequency of the various heavy minerals are as follows: 0 = none found, R = rare (<1%), S = scarce (1–2%), FC = fairly common (2–5%), C = common (5–10%), VC = very common (10–20%), FA = fairly abundant (20–35%), A = abundant (35–60%), and VA = very abundant (>60%).

[b] Ferromagnesium group includes such minerals as blue-green, brown-green, and brown hornblende, tremolite, actinolite, glaucophane, enstatite, augite, and hypersthene.

[c] Accessories include such minerals as andalusite, siderite, kyanite, muscovite, biotite, and sphene.

APPENDIX E: ATTERBERG LIMIT VALUES[a]

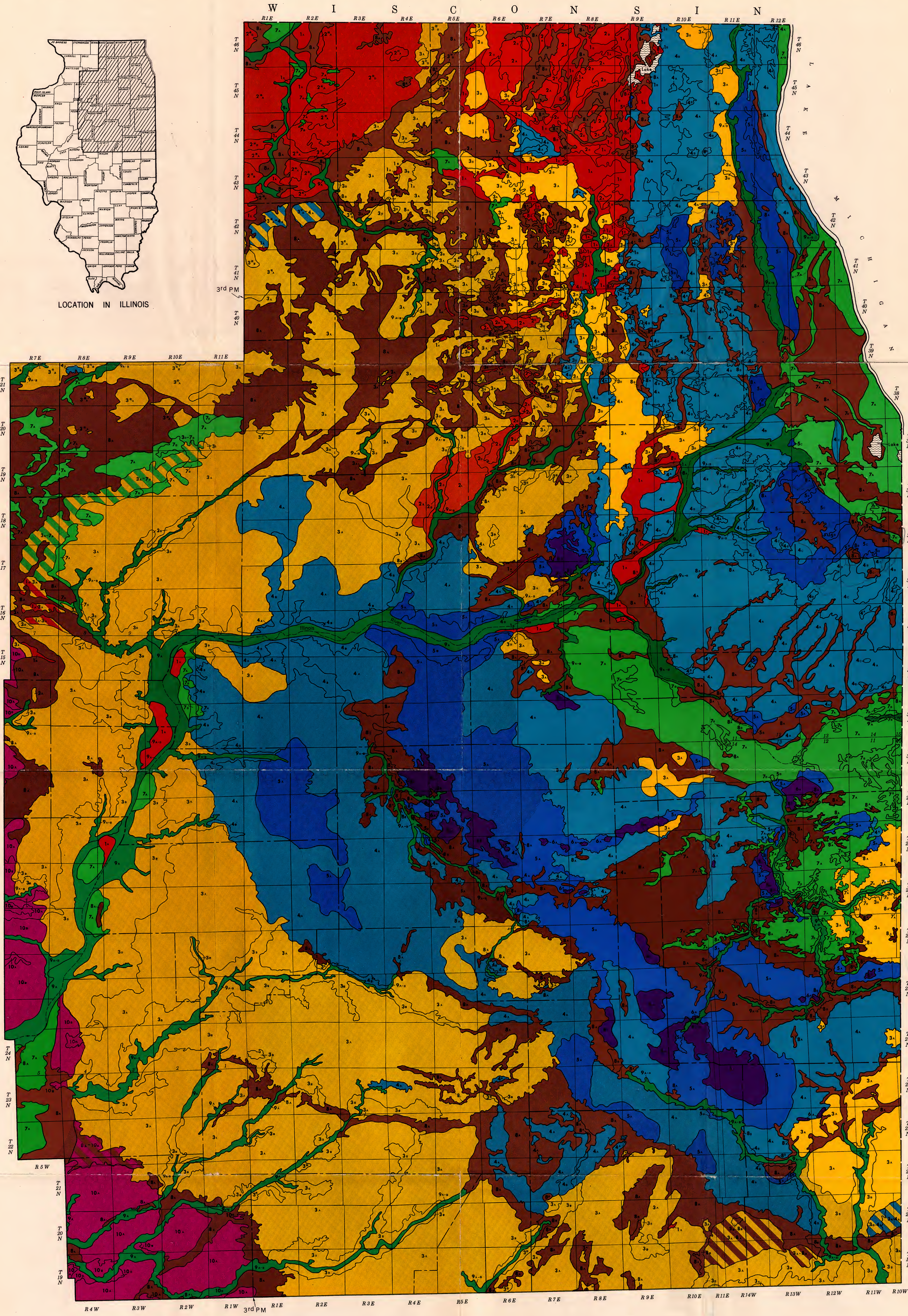
Profile number and soil series	Sample number	Horizon	Depth	Texture[b]	Liquid limit	Plastic limit	Plasticity index
			in.				
No. 1, Fox	17746	A_1	0–5	Silt loam	43.8	29.1	14.7
	17747	A_2	5–10	Silt loam	34.0	21.2	12.8
	17748	A_3–B_1	10–13	Silty clay loam	43.3	21.6	21.7
	17749	B_2	13–17	Silty clay loam	49.4	23.2	26.2
	17750	B_2	17–22	Silty clay loam	52.2	23.9	28.3
	17751	B_3	22–27	Clay loam	48.1	24.5	23.6
	17752	C_1	27–38	Variable	N.P.[c]	N.P.[c]	N.P.[c]
	17753	C_2	38–50+	Loamy gravel	N.P.[c]	N.P.[c]	N.P.[c]
No. 4, McHenry	17768	A_1	0–4	Silt loam	43.6	36.6	7.0
	17769	A_2	4–13	Silt loam	22.5	21.8	.7
	17770	B_1	13–17	Silty clay loam	35.3	21.6	13.7
	17771	B_{21}	17–27	Silty clay loam	38.0	21.3	16.7
	17772	B_{22}	27–33	Clay loam	32.2	15.8	16.4
	17773	B_3	33–37	Loam	24.9	15.9	9.0
	17774	C	37+	Sandy loam	N.P.[c]	N.P.[c]	N.P.[c]
No. 6, Miami	17731	A_1	0–3	Silt loam	34.1	28.0	6.1
	17732	A_{21}	3–7	Silt loam	21.8	19.2	2.6
	17733	A_{22}	7–10	Silt loam	20.1	17.4	2.7
	17734	B_1	10–15	Silty clay loam	28.0	18.8	9.2
	17735	B_2	15–18	Silty clay loam	34.1	19.5	14.6
	17736	B_2	18–22	Silty clay loam	36.4	18.7	17.7
	17737	B_3	22–29	Clay loam	34.7	18.5	16.2
	17738	C_1	29–34	Loam	27.3	17.0	10.3
	17739	C_2	34+	Loam	24.0	15.9	8.1
No. 9, Blount	17520	A_p	0–7	Silt loam	32.6	24.0	8.6
	17521	A_2	7–10	Silt loam	25.0	19.0	6.0
	17522	B_1	10–13	Silty clay loam	34.7	14.8	19.9
	17523	B_{21}	13–19	Silty clay	46.8	25.7	21.1
	17524	B_{22}	19–25	Silty clay	46.6	21.6	25.0
	17525	C_1	25–31	Silty clay loam	40.7	21.1	19.6
	17526	C_2	31–37	Silty clay loam	36.2	20.2	16.0
	17527	C_2	37–43+	Silty clay loam	35.2	19.2	16.0
No. 10, Eylar	17760	A_{11}	0–3	Silt loam	48.6	36.1	12.5
	17761	A_{12}	3–5	Silt loam	37.1	28.8	8.3
	17762	A_2	5–9	Silt loam	28.0	23.0	5.0
	17763	B_1	9–14	Silty clay loam	32.5	19.8	12.7
	17764	B_2	14–21	Silty clay	48.7	24.5	24.2
	17765	B_3	21–26	Silty clay	44.1	22.2	21.9
	17766	C_1	26–45	Silty clay	38.5	13.3	25.2
	17767	C_2	45–50+	Silty clay loam	29.6	18.2	11.4
No. 11, Eylar	17754	A_1	0–3	Silt loam	38.9	29.2	9.7
	17755	A_2	3–9	Silt loam	30.8	19.6	11.2
	17756	B_1	9–13	Silty clay	47.9	23.1	24.8
	17757	B_2	13–18	Silty clay	56.4	22.8	33.6
	17758	C_1	18–28	Silty clay	46.0	21.4	24.6
	17759	C_2	28–50+	Clay	47.0	23.6	23.4
No. 16, Warsaw	17612	A_1	0–5	Silt loam	44.8	29.2	15.6
	17613	A_1	5–10	Silt loam	45.2	29.6	15.6
	17614	A_3–B_1	10–13	Silty clay loam	46.3	27.7	18.6
	17615	B_2	13–19	Silty clay loam	46.1	26.8	19.3
	17616	B_2	19–25	Silty clay loam	39.4	19.7	19.7
	17617	B_3	25–29	Sandy clay loam	30.9	19.1	11.8
	17618	C	29–40	Loamy gravel	N.P.[c]	N.P.[c]	N.P.[c]
	17619	C	40–50+	Loamy gravel	N.P.[c]	N.P.[c]	N.P.[c]
No. 17, Ringwood	17595	A_1	0–4	Silt loam	43.9	29.0	14.9
	17596	A_1	4–9	Silt loam	38.7	24.7	14.0
	17597	A_3	9–11	Silt loam	36.8	22.9	13.9
	17598	B_1	11–17	Silty clay loam	35.7	21.8	13.9
	17599	B_2	17–25	Clay loam	30.7	18.6	12.1
	17600	B_{31}	25–29	Sandy clay loam	25.8	16.5	9.3
	17601	B_{32}	29–34	Loam	24.8	16.0	8.8
	17602	C	34–48+	Sandy loam	15.6	14.2	1.4
No. 19, Saybrook	17775	A_1	0–11	Silt loam	48.8	29.0	19.8
	17776	A_3	11–17	Silt loam	46.6	29.2	17.4
	17777	B_1	17–21	Silty clay loam	49.1	29.7	19.4
	17778	B_2	21–28	Silty clay loam	51.2	28.6	22.6
	17779	B_3	28–35	Clay loam	35.1	17.3	17.8
	17780	C	35–50+	Silt loam	25.3	16.8	8.5

Profile number and soil series	Sample number	Horizon	Depth	Texture[b]	Liquid limit	Plastic limit	Plasticity index
			in.				
No. 22, Elliott	17504	A_{11}	0–7	Silt loam	52.7	35.3	17.4
	17505	A_{12}	7–12	Silt loam	45.2	29.6	15.6
	17506	B_1	12–16	Silty clay loam	44.6	24.7	19.9
	17507	B_{21}	16–21	Silty clay	51.2	25.1	26.1
	17508	B_{22}	21–24	Silty clay	49.2	20.7	28.5
	17509	C	24–31	Silty clay loam	42.2	21.3	20.9
	17510	C	31–38	Silty clay loam	37.4	20.0	17.4
	17511	C	38–43+	Silty clay loam	34.6	19.4	15.2
No. 24, Swygert	17790	A_{11}	0–8	Silt loam	54.3	34.4	19.9
	17791	A_{12}	8–11	Silt loam	50.4	31.1	19.3
	17792	B_1	11–14	Silty clay loam	47.0	29.8	17.2
	17793	B_{21}	14–18	Silty clay loam	50.2	27.2	23.0
	17794	B_{22}	18–23	Silty clay	51.3	27.1	24.2
	17795	B_{23}	23–27	Silty clay	49.1	23.7	25.4
	17796	C_1	27–31	Silty clay loam	44.1	22.5	21.6
	17797	C_2	31–40+	Silty clay loam	35.5	19.0	16.5
No. 26, Clarence	17740	A_1	0–5	Silty clay loam	54.4	35.8	18.6
	17741	A_3	5–8	Silty clay loam	51.4	31.0	20.4
	17742	B_{21}	8–11	Silty clay	66.6	28.4	38.2
	17743	B_{22}	11–15	Clay	64.2	28.1	36.1
	17744	C_1	15–24	Clay	53.8	23.6	30.2
No. 29, Drummer	17781	A_{11}	0–9	Silty clay loam	61.8	36.4	25.4
	17782	A_{12}	9–16	Silty clay loam	55.0	26.1	28.9
	17783	B_1	16–21	Silty clay loam	51.4	23.1	28.3
	17784	B_{21}	21–25	Silty clay loam	52.4	21.8	30.6
	17785	B_{22}	25–29	Silty clay loam	51.1	24.7	26.4
	17786	B_3	29–35	Silty clay loam	50.7	21.6	29.1
	17787	C_1	35–50	Silty clay loam	47.6	22.1	25.5
	17788	C_{21}	50–54	Fine gravelly loam	25.2	14.8	10.4
	17789	D	60–65+	Loam	27.0	16.2	10.8
No. 30, Ashkum	16490	A_1	0–2	Silty clay loam	52.7	32.2	20.5
	16491	A_1	2–4	Silty clay loam	50.1	34.4	15.7
	16492	A_1	4–6	Silty clay loam	48.8	32.9	15.9
	16493	A_1	6–8	Silty clay loam	47.8	30.3	17.5
	16494	A_1	8–10	Silty clay loam	45.9	27.8	18.1
	16495	A_3–B_1	10–12	Silty clay loam	45.2	25.1	20.1
	16496	A_3–B_1	12–15	Silty clay loam	43.8	22.2	21.6
	16498	B_{22}	18–21	Silty clay loam	46.2	22.2	24.0
	16500	B_3	24–27	Silty clay loam	41.0	22.2	18.8
	16502	C	30–34	Silty clay loam	37.9	20.2	17.7
	16504	C	38–44	Silty clay loam	32.7	19.6	13.1
	16505	C	44–50	Silty clay loam	36.6	20.2	16.4
No. 31, Bryce	16473	A_1	0–2	Silty clay loam	60.4	33.5	26.9
	16474	A_1	2–4	Silty clay loam	57.7	35.1	22.6
	16475	A_1	4–6	Silty clay loam	55.6	32.5	23.1
	16476	A_1	6–8	Silty clay loam	57.4	31.8	25.6
	16477	A_1	8–10	Silty clay loam	56.3	30.2	26.1
	16478	A_1	10–12	Silty clay loam	54.0	29.2	24.8
	16479	B_1	12–15	Silty clay	53.2	24.6	28.6
	16481	B_{21}	18–21	Silty clay	53.8	25.5	28.3
	16483	B_{23}	24–27	Silty clay	55.6	26.4	29.2
	16485	B_3	30–34	Silty clay	52.1	24.1	28.0
	16487	C_1	38–44	Silty clay	45.3	22.0	23.3
	16488	C_2	44–54	Silty clay	40.8	20.0	20.8
	16489	C_2	54–58+	Silty clay	39.4	20.4	19.0
No. 33, Rowe	16455	A_1	0–2	Silty clay loam	61.1	38.6	22.5
	16456	A_1	2–4	Silty clay loam	58.2	35.1	23.1
	16457	A_1	4–6	Silty clay loam	52.8	30.5	22.3
	16458	A_1	6–8	Silty clay loam	53.5	27.8	25.7
	16459	A_3	8–10	Silty clay loam	57.5	24.8	32.7
	16460	B_1	10–12	Silty clay loam	59.4	27.2	32.2
	16462	B_{21}	15–18	Silty clay	60.1	27.8	32.3
	16463	B_{22}	18–21	Silty clay	61.9	25.0	36.9
	16465	B_{22}	24–27	Silty clay	61.4	25.2	36.2
	16467	B_3	30–34	Silty clay	58.8	24.4	34.4
	16469	C_1	38–44	Silty clay	55.0	22.0	33.0
	16471	C_2	53–57+	Silty clay	45.6	21.6	24.0

[a] These data were obtained in the University of Illinois Department of Civil Engineering laboratory under the direction of T. H. Thornburn, Professor of Civil Engineering.
[b] Textures are those determined in the field without benefit of particle-size distribution data (see Appendix A).
[c] N.P. = nonplastic material.

5M—11-60—71750

PARENT MATERIAL AND SURFACE COLOR OF SOILS IN NORTHEASTERN ILLINOIS



LEGEND

MATERIAL OF WISCONSIN GLACIAL AGE OR YOUNGER

A 1 LOAMY GRAVEL TILL AND OUTWASH

B 2 SANDY LOAM TILL

B 3 LOAM TILL

C 4 SILTY CLAY LOAM TILL

D 5 SILTY CLAY TILL AND SMALL AREAS OF LACUSTRINE SEDIMENTS

D 6 CLAY TILL AND SMALL AREAS OF LACUSTRINE SEDIMENTS

7 SANDY LOAMS AND SANDS, WATER AND/OR WIND DEPOSITED

mixed

8 MEDIUM AND MODERATELY FINE TEXTURED OUTWASH

9 MIXED BOTTOMLAND, TERRACE AND BLUFFWASH MATERIALS

LOESS MORE THAN 2 FEET THICK

MATERIAL OF ILLINOIAN GLACIAL AGE BELOW LOESS

10 GLACIAL TILL

COLOR OF SURFACE

A DARK COLORED SOILS DEVELOPED UNDER PRAIRIE VEGETATION

B LIGHT COLORED SOILS DEVELOPED UNDER FOREST VEGETATION

C MODERATELY DARK COLORED SOILS DEVELOPED UNDER MIXED PRAIRIE AND FOREST VEGETATION

* UPPER 2-1/2 FEET OR MORE OF WISCONSIN TILL USUALLY LEACHED

STATE BOUNDARY

COUNTY BOUNDARY

TOWNSHIP BOUNDARY

RIVER

N / W / E / S

Scale

0 3 6 12 18 24 miles

UNIVERSITY OF ILLINOIS AGRICULTURAL EXPERIMENT STATION

1957

(Special table for Illinois Agricultural Experiment Station Bulletin 665, November, 1960.)

Soil Series of Northeastern Illinois, Including Soils Derived from <5 Feet of Loess or Other Surficial Material on Till or Outwash, from Sandy Materials, and from Alluvial Sediments, All of Wisconsin Glacial Age or Younger[a]

(Soil series shown in **boldface** are those studied in the laboratory [see Appendixes A and C])

A

Area on colored map	Thickness and kinds of parent material; some solum features	Thickness of solum	Regosol	mixed forest origin Gray-Brown Podzolic			Gray-Brown Podzolic intergrade to Brunizem			Planosol intergrade to Gray-Brown Podzolic	underlain by hardpan Planosol intergrade to Brunizem			prairie soil Brunizem			Humic-Gley	
			Variable oxidation and drainage[b]	Well oxidized and drained[b]	Moderately well oxidized and drained[b]	Imperfect oxidation and drainage[b]	Well oxidized and drained[b]	Moderately well oxidized and drained[b]	Imperfect oxidation and drainage[b]	Poorly oxidized and drained[b]	Imperfect oxidation and drainage[b]	Poorly oxidized and drained[b]	Very poorly oxidized and drained[b]	Well oxidized and drained[b]	Moderately well oxidized and drained[b]	Imperfect oxidation and drainage[b]	Poorly oxidized and drained[b]	Very poorly oxidized and drained[b]
	0″ to 10″±2″ loam or silt loam on calcareous loamy gravel drift	<10″	Rodman A															
	10″ to 21″±3″ loam or silt loam on calcareous loamy gravel drift	10″ to 21″		Casco A										Lorenzo A				
A 1	21″ to 39″±3″ loam or silt loam on calcareous loamy gravel drift	21″ to 39″		**Fox**		Homer	Dresden		Matherton					**Warsaw**		Kane	Will	
	39″ to 60″±6″ loam or silt loam on calcareous loamy gravel drift	>36″		Ockley			Longlois							Wea[c]			Abington	
	39″ to 60+″ loam or silt loam on coarse textured drift; thick A horizon	>42″										Knight			Troxel			
	0″ to 10″±2″ loam or silt loam, <18″ to calcareous sandy loam till	<18″	Hennepin B															
	0″ to 12″±2″ loam or silt loam, <42″ to calcareous sandy loam till	18″ to 42″		Lapeer										Griswold				
B 2	12″ to 39″±3″ silt loam (loess), <48″ to calcareous sandy loam till	36″ to 48″		**McHenry**			Nippersink							**Ringwood**				
	18″ to 39″±3″ silt loam (loess), >48″ to calcareous sandy loam till	>42″		Pecatonica			Argyle		Beaver								Dunham	
	39″ to 60″±6″ silt loam (loess), >42″ to calcareous sandy loam till	>36″		St. Charles		Kendall	Batavia		Virgil					Plano		Elburn	Dunham	
	0″ to 10″±2″ loam or silt loam, <18″ to calcareous loam till	<18″	Hennepin B															
	0″ to 15″±3″ loam or silt loam, <24″ to calcareous loam till	18″ to 24″		Strawn B										La Rose B				
	0″ to 15″±3″ loam, silt loam (loess), or sandy loam, 24″ to 42″ to calcareous loam till; B horizon all in loam till	24″ to 42″		**Miami** B	Celina[e] B	Crosby[e] C	Octagon[e]	Mont-morenci	Otterbein[e]					Parr[e] B	Corwin[e] B	Odell[e]		
B 3	15″±3″ to 39″±3″ silt loam (loess), <42″ to calcareous loam till; B horizon in loess and loam till	<42″		Dodge[e]	Mayville[e]	Clyman[e]			Herbert					**Saybrook**[d]	Saybrook	Lisbon	**Drummer**	
	15″±3″ to 39″±3″ silt loam (loess), >42″ to calcareous loam till; B horizon in loess and till	>42″		Russell	Xenia	Fincastle[e]	Mellott[e]	Wingate	Toronto					Sidell	Dana	Raub[e]	Drummer	
	39″±3″ to 60″±6″ silt loam (loess), 42″ to 60″ to calcareous loam till; B horizon primarily in loess	>42″		Manlove[e]	Birkbeck	Reesville[e]			Sunbury	Ward				Catlin	Allerton[e]	Flanagan	Drummer	
	15″±3″ to 39″±3″ sandy material, <42″ to calcareous loam till	<42″		Metea										Ayr				
	0″ to 10″±2″ loam or silt loam, <18″ to calcareous silty clay loam till	<18″	Chatsworth D															
	0″ to 24″±3″ loam or silt loam, <42″ to calcareous silty clay loam till[e]	18″ to 42″			Morley C	**Blount** C			**Beecher** C						Varna C	**Elliott** C	**Ashkum**[f] C	
C 4	24″ to 60″±6″ loam or silt loam (predominantly drift), <60″ to calcareous silty clay loam till	<42″													Symerton	Andres		Peotone
	24″ to 60″±6″ silt loam (loess), <60″ to calcareous silty clay loam till	<42″			Birkbeck											Flanagan	Drummer	
	18″ to 39″±3″ sandy material, <42″ to calcareous silty clay loam till	<42″												Rankin		Wesley		
	0″ to 10″±2″ loam or silt loam, <18″ to calcareous silty clay drift	<18″	Chatsworth D															
	0″ to 24″±3″ loam or silt loam, <36″ to calcareous silty clay drift[e]	18″ to 36″				**Eylar** D			**Frankfort** D			Monee D	Monee D			**Swygert** C	**Bryce**[f] D	
D 5	24″ to 60″±6″ loam or silt loam (predominantly drift), <60″ to calcareous silty clay drift	<42″														Mokena		Rantoul
	24″ to 60″±6″ silt loam (loess), <60″ to calcareous silty clay drift	<42″														Rutland[e]		
	18″ to 39″±3″ sandy material, <42″ to calcareous silty clay drift	<42″														Papineau		
	0″ to 10″±2″ loam or silt loam, <18″ to calcareous clay drift	<18″	Chatsworth D															
	0″ to 24″±3″ loam or silt loam, <36″ to calcareous clay drift[e]	18″ to 36″				**Eylar** D			Frankfort D			Monee D	Monee D			**Clarence** D	**Rowe**[f] D	Rowe D
D 6	24″ to 60″±6″ loam or silt loam (predominantly drift), <60″ to calcareous clay drift	<42″														Mokena		Rantoul
	24″ to 60″±6″ silt loam (loess), <60″ to calcareous clay drift	<42″														Rutland[e]		
	18″ to 39″±3″ sandy material, <42″ to calcareous clay drift	<42″														Papineau		
	0″ to 60+″ sandy material; no textural B horizon <60″	>60″		Plainfield A			Oquawka A							Hagener A		Watseka A	Maumee D	
	0″ to 60+″ sandy material; weak textural B horizon between 42″ and 60″	>42″		Bloomfield A										Ade A				
7	0″ to 60+″ sandy material; thick A_1 horizon, weak textural B horizon <42″	<42″												Disco B				
	0″ to 60+″ sandy material; thin to medium A_1 horizon, weak textural B horizon <42″	<42″		Unity A		Cowling B	Billett A							Sumner A		Hoopeston		
	0″ to 60+″ sandy material; moderate to strong textural B horizon <42″	>30″		Alvin B		Roby C						Orio C	Milroy D	Onarga B		Ridgeville B	Pittwood B	
	0″ to 21″±3″ loam or silt loam on sand and fine gravel, calcareous >42″	>42″		Stonington B										Stockland B				
9 B 7 C 2 D	21″ to 39″±3″ loam or silt loam on sand and fine gravel, calcareous >45″	<42″		Ellison														
8	21″ to 39″±3″ loam on stratified silts and sands, calcareous >36″	>36″														LaHogue	Selma B	
	0″ to 39″±3″ silt loam on stratified silts and sands, calcareous >36″	>36″		Camden B		Starks C	Harvard		Millbrook B	Sexton D	Cullo[c] C	Thorp C	Brooklyn D	Alexis B	Proctor B	Brenton B		Peotone C
	0″ to 21″±3″ silt loam on silty clay loam outwash, calcareous >36″	>36″				Del Rey C	B	D	C	B						Martinton C	Milford C	
9	Areas numbered 9 on colored map include primarily dark-colored bottomland soils such as Huntsville, Otter, Sawmill, DuPage, and Millington; however, many dark-colored and light-colored terrace soils of various textures are also included because the scale of the map did not permit delineating parts of the extremely complex soil pattern along many streams.																	
10	Soils in these areas are developed primarily in loess 10 to 20 feet thick over weathered Illinoian till.																	

[a] Soils occurring in this region but not included in this key are: organic soils, medium- to fine-textured outwash soils calcareous above 36 inches, soils derived from loess greater than 5 feet thick, and soils underlain by bedrock at less than 5 feet. Minor areas of all of these occur in several delineations on the colored map.
[b] Drainage terms refer to natural drainage.
[c] These soils occurring in northeastern Illinois are not correlated to date.
[d] Profile No. 20 (see Appendixes A and C) probably has less than 15 inches of loess.
[e] If loess is thicker than about 18 inches these series are mapped only where one-third or more of the B horizon is developed from the underlying till.
[f] Ashkum, Bryce, and Rowe are mapped where local water-deposited sediments are up to 40 inches thick on till.